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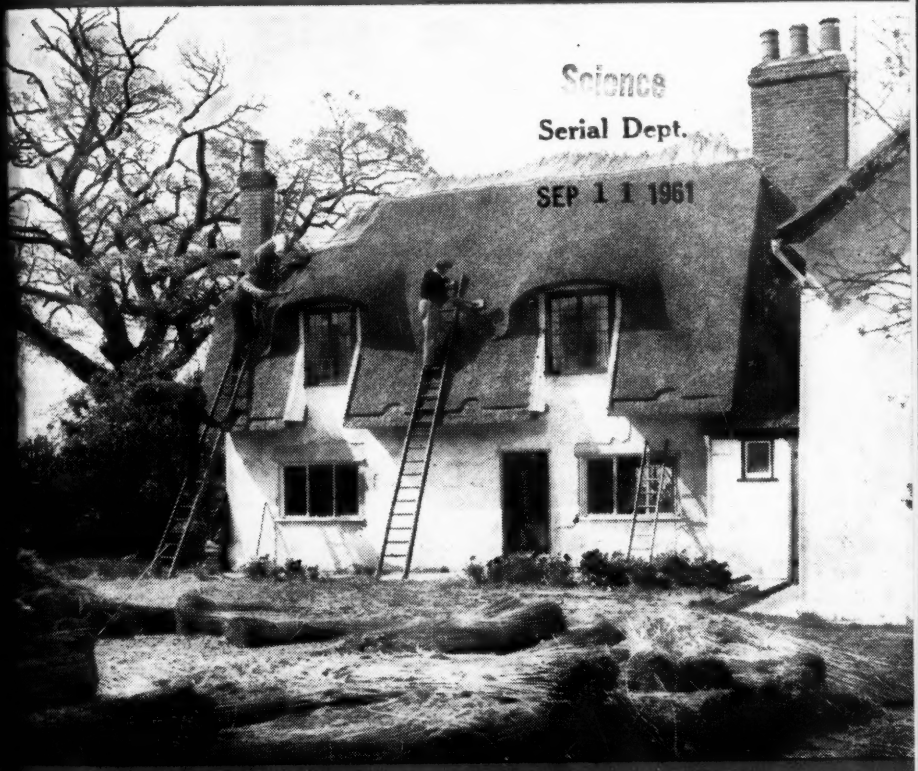

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Thatching with Norfolk reed at Pebmarsh, Essex

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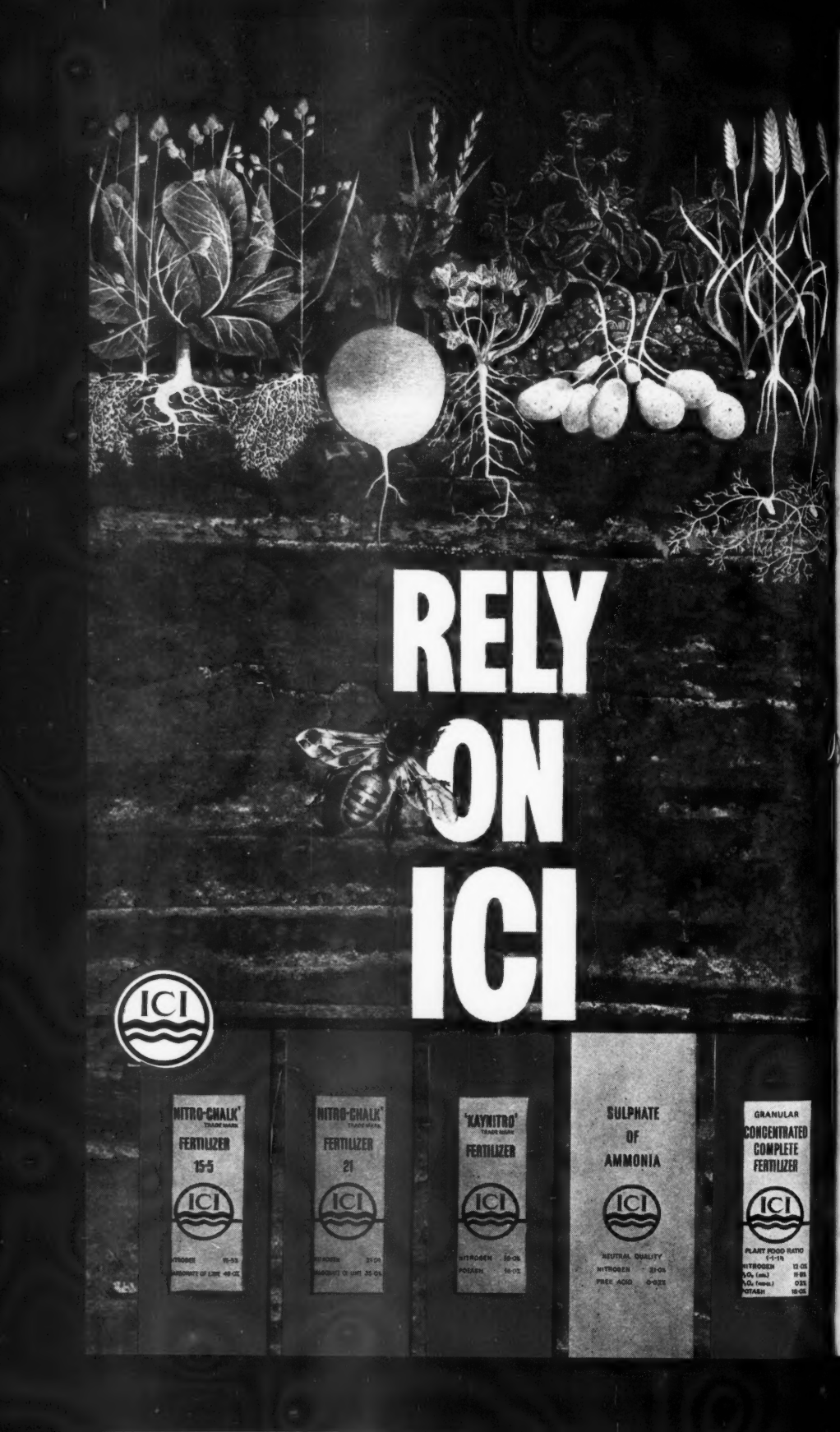
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Agriculture

Volume 68 Number 5 August 1961

EDITORIAL OFFICES
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Cover Photograph: Thatching with Norfolk reed at Pebmarsh, Essex *Frank Walsh*

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Autumn Grass

J. D. IVINS, M.SC., PH.D.
University of Nottingham

Where high levels of animal production from grass in autumn have been recorded, herbage of high digestibility has been produced. Professor Ivins suggests how this may be done

AT first sight autumn grass is a mystery. It is often held that silage made in the autumn is much less valuable for milk production than that made in late spring. Particularly in a wet autumn such as we experienced in 1960, pastures may be covered with abundant herbage and yet milk yields may decline day by day unless supplementary feeding is increased. The feeding value of autumn grass may be overestimated. Frequently stock may not relish it, and this problem may be aggravated by their refusal to eat herbage fouled by dung earlier in the season. Yet there are other cases where high levels of milk production are obtained from September to November on grass alone, and even in December (1955) steers on the University of Nottingham farm at Sutton Bonington showed average daily gains between 1·7 and 2·6 lb live weight on grazing alone.

Importance of digestibility

The answer to these anomalies must in part lie in the variable quality of autumn grass, and a guide to quality is provided by a study of the extent to which herbage is digested by the animal. Unless a material is digested and the nutrients enter the bloodstream it is of no value to the animal for body function, growth or the production of milk. Herbage of low digestibility is more of a fill than a feed. The low dry matter content of autumn grass is sometimes held responsible for reduced milk yields, but dry matter yields and contents as such, without recognition of the constituents of the dry matter, may be misleading and pointless. Evidence is accumulating which suggests that the amount of herbage dry matter eaten by an animal is closely related to its digestibility. As digestibility falls, so does intake, and hence the quantity of digestible nutrients falls even more rapidly, for less is eaten and what is eaten is less digestible. Digestibility of herbage is a characteristic of the herbage alone, for dairy cows of different breeds and levels of milk production and sheep also digest similar herbage to the same extent. The fate of nutrients

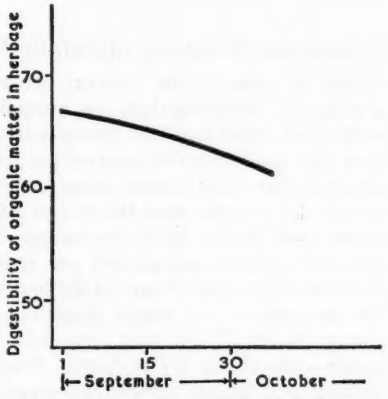

Fig. 1. Fall in digestibility of herbage as autumn advances (two swards.)

after digestion is of course a very different matter and is determined by the metabolism of the animal; but high yields, whether of milk or liveweight gain, require herbage of high digestibility.

Raymond and his co-workers at Hurley have clearly demonstrated that different species of grasses vary in digestibility, and that digestibility falls rapidly as soon as flower-heads appear and continues to fall as the plant matures. This fact, confirmed at several other centres, is of utmost importance in attempts to obtain high levels of animal production from fresh or conserved herbage.

The digestibility of autumn grass was investigated at Sutton Bonington in 1960. Two swards, one dominated by perennial ryegrass, the other a mixture of timothy, meadow fescue and white clover, were set aside after a hay crop had been taken in June; samples of herbage were taken at ten-day intervals throughout September and early October, and the digestibility was determined with sheep. The results are shown in Fig. 1, which shows clearly that as the season advances so the feeding value of the herbage declines. The digestibility of both herbages fell, but the decline was faster with perennial ryegrass at this time of the year. Naturally, silage made in late September from herbage of little more than 60 per cent digestibility (expressed as a percentage of the organic matter) cannot be as good for milk production as silage made in early May, when the digestibility of the herbage may be as high as 75 per cent. Stock will eat less of this grass both in the fresh and conserved state, and in consequence production is lower. Animal production from grass in the autumn rests on those techniques which are known to produce highly digestible feed.

Techniques producing digestible feed

First of these is the interval between defoliation either by cutting or grazing, for flowering does not normally present a problem in the autumn unless seed–heads from the previous summer are still on the pasture. On the basis that the longer this interval the greater the fall in feeding value, we can conclude that to be of great value to the animal autumn grass must be grown rapidly. So we must have the species and varieties of grasses which will grow at this time. Best of all in this respect is Italian ryegrass, but the majority of our sown grasses and clovers are active until frosts occur. Maiden seeds, which usually do not flower in the first year, are excellent, and white clover is also productive and highly digestible at this time. Herbage with organic matter of over 75 per cent digestibility was taken from a timothy-meadow fescue-white clover ley at Sutton Bonington in mid-October 1958, but this herbage had grown rapidly following a cut a fortnight previously and had been given little chance to fall in feeding value.

Fertilizers appear to have no immediate effects on the digestibility of herbage, but of course they greatly affect the quantities of herbage and hence digestible nutrients produced. Long-term effects of fertilizers coupled with management are brought about via botanical changes in the sward.

Seasonal productivity of grassland

An indication of the seasonal productivity of grassland is given in Fig. 2 on p. 231. The time of commencement of growth in spring is determined by

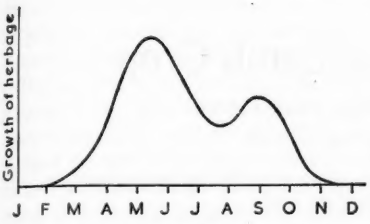

Fig. 2. Average seasonal productivity of grassland.

species, varieties, temperature, nitrogen supply and other factors, but generally after the flush of growth in May there is a decline in productivity, dependent on management and particularly on rainfall. A further, but smaller, flush of growth takes place in early autumn. To draw lessons on the management and utilization of grassland at this time let us consider two distinct systems, bearing in mind that some farming systems such as those specializing in early lamb production or grass-finished beef may not need or could not economically utilize high grass productivity in autumn, when stocking rates may be low.

Firstly we may have a pasture which has been grazed at a set rate of stocking throughout the whole spring and summer. Depending on the severity of the July-August fall in production, herbage will have accumulated on the pasture over the whole summer, and the material offered to stock in late September may consist of new growth together with herbage produced several weeks, or in a wet year several months, previously. Such material will be variable in quality, but more often than not in a wet year it will be of low digestibility, with all that that implies.

The second pasture may have been cut for silage and/or grazed at intervals throughout the season, with rest periods to allow recovery. These rest periods may only have been a fortnight long during the flush of growth, and nitrogenous fertilizers may have been given several times to encourage rapid growth and hence a substantial crop for cutting or grazing. The last cut may have been taken at the beginning of September and further nitrogenous fertilizer given immediately. Thus the herbage in late September will be unfouled, rapidly grown and so acceptable and very nutritious. It is under these conditions, rather than those given in the first example, that high levels of animal production are likely to be obtained from grass in autumn. If surplus grass is present on the pasture in late summer this is best cut for silage while it is still of reasonably high feeding value, rather than left to deteriorate in the field. This extra silage may also contribute to future grassland production by facilitating an earlier removal of cattle from the pastures in winter, with a most desirable reduction in poaching.

As the end of the grazing season approaches snap decisions are required, depending on the state of the pastures. In the autumn of 1959 they were bare enough as a result of the summer drought, but even then when rains came the rapidly-grown herbage proved of high feeding value. The following year, with a wet summer and autumn, grass was abundant and probably less was utilized. If the supply of grass is sufficient to warrant a silage cut, this is best taken early to provide re-growth of high feeding value, otherwise the silage or the grazing, if no cut is taken, will be of low quality.

Looking to the Lamb Crop

J. E. NICHOLS, M.Sc., PH.D., F.R.S.E.
University College of Wales

Professor Nichols considers the factors which affect the lambing percentage and the health of the lambs.

BY this time of the year most sheep farmers have decided upon, or found themselves committed to, the broad framework of their breeding and lamb production policies. The chief factors which affect scale, methods, aims, and production fall into two main categories. In the first instance, there are the "farm factors", arising from the nature, location, and organization of the farm itself; these largely determine flock numbers, type of breeding stock, time of lambing, the lambing fields and methods of management and feeding.

The second series of factors work within the scope of the first, and may be called the "flock factors"—those which affect the care, husbandry, hygiene, and disease prevention and control that make for a successful lamb crop. The main principles of flock husbandry are reasonably well established from experience and investigation, and apply fairly generally throughout the sheep industry as a whole, whatever the local pattern of sheep farming may be. Since the lamb crop is the basic product of all breeding flocks, attention should at all times be focused on those flock factors which affect it. Also, since ewes spend some eight or nine months out of every twelve carrying and nursing their lambs, ewe management should not be taken lightly, but carried out as a regular routine to lead up to a successful lamb crop.

The recently used term "scavenging flock" is perhaps unfortunate in its suggestion that such a flock needs little attention and is nobody's particular business except at odd times of the year. If the purpose of such a flock is to exploit otherwise unused residues and surpluses of crops and grazing, then "salvage" might be better than "scavenge".

Preparation for tupping

In the flock reproductive cycle, preparation for tupping is as important as preparation for lambing, and the need to get the ewe flock into good shape for breeding—between the times of weaning the previous lamb crop and of joining the rams for service—sets many practical problems of late summer and autumn management. While it is easy to say that after weaning the ewes should be fed less to dry them off and to bring them down in condition, so that they are in the desirable improving condition for mating, it is not always easy to do this. An overfat ewe flock before and at mating is not a good basis for a good lambing percentage; and ewes of the smaller breeds and types often tend to have too much condition at this time of the year and are more difficult to fine down than bigger framed ewes when put on poorer keep. There is plenty of evidence that a rising level of feed for a few weeks before putting in the rams tends to raise the rate of ovulation and bring more of the ewes into season together, thus making for higher fertility and a shorter lambing period. The process of "flushing" the ewes for this purpose involves giving the flock

better nutritional conditions for 2-3 weeks before turning in the rams; and, in practice, it does not seem to matter so much what change of feed or grazing is used so long as the change is for the better.

Before this time, however, the ewes should have been checked for any unsoundness; ewes that have bad quarters, bad mouths or feet, or have been poor mothers or milkers should be culled from the breeding flock. The aim should be for the entire flock to conceive and carry their lambs to term, although relatively few flocks get through without some ewe deaths or abortions. Where fluke is known or suspected to be present, ditches and drainage should have been attended to and routine dosing against fluke started by about early October; similarly, vaccination against black disease should be undertaken. When ewes are bought in to make up flock numbers or drafted down from hill grazings, dosing against fluke and/or worms should be carried out, and a schedule of routine dosings for the whole flock worked out for the winter and early spring.

Prevention better than cure

All sheep farmers know the great advances that have been made in the prevention and treatment of the many diseases which affect the pregnant ewe; valuable information is given in the Ministry's Bulletin No. 170, *Diseases of Sheep*. But as the flockmaster's emphasis should be even more on prevention than on cure, it is well worth his while to take proper veterinary advice on the possible incidence of disease, early in the season, rather than gamble on getting away with it. Similarly, since correct treatment depends on proper diagnosis, prompt consultation with the veterinary practitioner and the Veterinary Investigation Service is essential once disease has appeared or is suspected. Many of the necessary vaccines and sera are now readily available, and the skilled and proper use of the "needle" is an essential part of the shepherd's equipment.

Good examples of what has just been suggested are the possible losses from enzootic abortion, against which the first vaccination should be made before the ewes are tupped, followed by a second later on; and the precautions against lamb dysentery and pulpy kidney by any necessary vaccination of ewes about tupping time, and again shortly before they lamb.

Management of the ram

To return, however, to management questions before the breeding season starts: a relatively small but important point which is often overlooked is that it helps service if the tail region of the ewe is clipped and cleaned up before putting in the rams. The rams, like the ewes, should be in good physical condition without defects, and should get some extra feeding while at active service, especially in the first few weeks of the season, when numbers of ewes are coming on heat more or less simultaneously.

On the other hand, it is unreasonable to expect a newly-bought ram which may have been well fed and brought out for a show and sale to begin active and successful service straight away when brought home and put in at once with the ewes.

The allowance of ewes per ram varies, and the ram team should be chosen with the usual management of the flock in mind. No hard and fast rules can

be laid down as the system of mating varies from farm to farm, largely according to how far the flock as a whole, or when divided into mating groups, is controlled. While an average allocation may be one ram to some 50 or 60 ewes, if the ram has to find and stay with his ewes in large fields or on the open hill a narrower ratio should be used. An experienced, active, second-season ram in more restricted areas or small paddocks can use more ewes, while a ram lamb should be given fewer. Where the flock can be divided into age groups, older rams are usually joined with the younger ewes, ram lambs being put to the older ewes. In pedigree flocks individual rams are often put to small selected groups of ewes. In some flocks, especially the larger stud flocks, systems of hand mating are practised in which the ewes on heat are identified in the field or small paddocks by "teaser" rams and brought in to the selected ram for service individually. In such cases 200 or more ewes can be covered by one ram. The object should be to get as many of the ewes as possible served in their earlier heat periods of the season, as this generally gives the more fertile matings, and the lambing is not unduly spread out by delayed matings. To this end it is better to have too many rams rather than too few, and certainly to have one or more in reserve in case the ewes are coming back to service, and any change-over or addition of rams should be made in the first 4 weeks or so rather than towards the end of the normal 7-8 weeks for which the rams are left to run with the ewes.

How are the rams working?

The ways in which the rams are working should be carefully noted. Ewes can be missed if a ram tends to hang around a particular ewe and neglect the others; competition may be good for him but where more than one ram is in, bullying and fighting should be watched for. With ewe heat periods recurring at 14-18 days, those which have been served can be identified by the usual practice of raddling the rams on the brisket, changing the colours about every sixteen days and progressing to a deeper colour each time. (Special harness and colour blocks are now available for this purpose). In pedigree flocks this is essential for proper recording; in commercial flocks it shows how the rams are working.

In recent years, particularly, where the lambing rate or productivity of the flock as a whole has become more carefully considered, the practice of mating ewe hoggs in their first year has become more widespread. Early born and well grown ewe lambs will come in season; if they are kept doing well without an autumn check, some 60 per cent or more of them will take the ram successfully, but somewhat later than the older ewes. Whether they can be kept as a separate group depends upon the flock numbers and farm facilities; in any event it is generally desirable that the ram used on them should be an older one, preferably not too big-boned and heavy.

Needs of the in-lamb ewe

From the time the rams are taken out, the management of the ewe flock should follow the sensible lines appropriate to a group of pregnant females, i.e. recognizing that a fit condition in early gestation, without overfeeding, gives a better basis for improving nutritional level in the later stages. The developing lamb makes no significant demands on the dam's metabolism

until the last 2 months of pregnancy, during which most of the foetal growth occurs and an overall increase in nutritional level is needed to provide for the building up of foetus, mammary function, and the general tone of the dam. With advancing pregnancy the needs of the flock impose progressively heavier demands upon the "farm factors", especially since late pregnancy is concurrent with midwinter for early lambing flocks and with most of the winter in later lambing flocks. The greater stress coincides with the lowered feed supplies of winter and the generally adverse weather conditions. To have ewes overfat early in pregnancy passing on to a shortage of grazing and feed towards the end of it is to set the stage for pregnancy toxaemia.

Provisions for feed, shepherding, and shelter must be well planned ahead so that good management can mitigate or, better, overcome the effects of the conflict between the rising demands of the ewes and the falling environment of feed and climate. And it is equally important that necessary routines of dosing and vaccination should be carried out.

A useful way of regarding a successful lamb crop is to think in terms of the number of sound, healthy lambs that can be born to a hundred ewes put to the ram. The figure obtained depends largely upon a low proportion of barren ewes, high fertility of matings, low mortality of ewes, prevention of disease, appropriate feeding levels for the different phases of pregnancy, and careful and consistent management of the flock up to the onset of the lambing season.

Agricultural Chemicals Approval Scheme

Additions to the 1961 List of Approved Products

The following products have been approved under the Agricultural Chemicals Approval Scheme since the first list of Approved Products was published on 1st February 1961.

INSECTICIDES

BHC (TECHNICAL BHC)—WETTABLE POWDERS

Bugges BHC Dispersible Powder 50% (6·5% gamma)—Bugges Insecticides Ltd.

FUNGICIDES

MERCURY: ORGANO-MERCURY FOLIAGE SPRAYS

"P.P." Liquid Mercury Plus—Plant Protection Ltd.

ZINEB—WETTABLE POWDERS

Unicrop Zineb—Universal Crop Protection Ltd.

Seed Dressings and Risk to Wild Life

Dressings containing dieldrin, aldrin and heptachlor can kill birds that eat treated seed. Great care should be taken not to leave any treated seed lying about when it is being stored or sown. Higher strength dressings for wheat bulb fly should be used only on winter wheat and then only in areas where there is a real danger of attack.

Dressings containing dieldrin, aldrin and heptachlor are not to be used at all for spring-sown grain.

Avoiding Litter Losses

G. W. WHITEHOUSE, N.D.A.

National Agricultural Advisory Service, Yorks and Lancs Region

Modern methods and good stockmanship can help all pig breeders to produce large litters, at good average birth weights (3½-4lb), and weaners of 40-50 lb in the summer and 35-45 lb in the winter, with a minimum of loss.

PIG breeders are well aware of the serious losses which occur amongst young pigs. A recent survey showed that the percentage loss up to eight weeks of age is 25·9, with the greatest loss, 15 per cent, during the first week. This means that out of the total pigs born alive an average of slightly over two pigs per litter die before weaning, a serious loss in production and profit for the individual breeder and in terms of food for the nation.

In-pig sows

Good husbandry, modern methods and attention to detail—good stockmanship—can reduce these losses considerably. The cycle really starts before service. It is essential to see that the sow is receiving an adequately balanced ration according to her weight and condition. She should be thriving and improving in condition, fit and active, not overfat and not emaciated through under-nourishment whilst mothering her previous litter, to enable her to produce sufficient healthy eggs for fertilization at service. She should continue to receive 6-8 lb of meal per day during the first 2-3 weeks of pregnancy. Lack of nourishment at this stage is considered to be a potent factor in the problem of re-absorption of the foetus and the subsequent birth of a small litter.

During mid-pregnancy the sow can be fed on bulky foods such as cooked potatoes or grazed on high quality grass, provided that a daily allowance of 2-3 lb of meal or nuts is given. These concentrates must contain protein, minerals and vitamins to enable her to build up reserves ready for the next lactation and to develop healthy and strong piglets. Later in the pregnancy the feeding of bulky foods should be discontinued and a sow ration including 10-12 per cent white fish meal used. This will provide the necessary protein supplement and also ensure a sufficient supply of calcium, phosphorus and sodium chloride (salt), whereas when using some other types of fish meal it may be necessary to add these mineral ingredients separately. The sow should have access to a supply of clean drinking water at all times, whether kept outside or indoors.

The use of individual sow feeders is an important point, especially where a number of in-pig sows run together. They prevent bullying and possible damage to the unborn pigs, allow the more timid sows to obtain their proper rations and at the same time stop the bullies overeating and becoming too fat.

Indoor farrowing

Whilst pigs are kept successfully outdoors on some farms, most pigs are farrowed indoors and it is proposed to deal, in the main, with indoor farrowing. A few days before she is due to farrow a sow should be introduced

to the farrowing pen and allowed to become acquainted with her new surroundings. She should not just be put in, shut in and forgotten until feeding times, but let out for adequate exercise. This is very necessary and important. She should be receiving a total ration of 8-10 lb when due to farrow, but this should be stopped for the last one or two days before and after farrowing and replaced with a sloppy bran mash. This light diet prevents constipation and limits the risk of a hard udder developing. The latter has been prevalent in the East Riding and the cause of many deaths of young piglets through starvation. The surviving piglets are generally weak and stunted and difficult to rear.

When farrowing starts, the sow should not be disturbed but should be kept under quiet observation in case of unforeseen difficulties which, though rare, may occur. She should be let out for a short walk within 24 hours of farrowing, and while she is out is a suitable time to cut the tusks of the piglets. This will prevent the young pigs injuring each other or the sow's udder.

After farrowing, the amount of food required by the suckling sow to maintain herself and produce milk for the piglets may be calculated by the old rule—2 lb a day for the sow and 1 lb for each piglet in the litter—but it is better to adjust the amount of ration so that, as far as possible, the condition of the sow is maintained throughout the suckling period. The addition of a little green food, kale or cabbage, will also be beneficial, and it is important to remember that sow's milk contains 6-8 per cent protein as compared with 3-5 per cent in cow's milk. See that she is supplied with the necessary 10-12 per cent of protein in her ration.

Farrowing pens

There are several types of farrowing pen, ranging from the New Zealand Ruakura to a crate, which are quite satisfactory when correctly used. All types should contain the sow in a narrow area to prevent her from turning round, and leave sufficient space between the floor and the bottom rails of the sow container to let the piglets escape from the sow into a warm, dry, draught-free box or dog kennel. This latter can be arranged on one side of the pen and should be heated. An infra-red lamp will do this successfully. It should be covered to prevent an upsurge of warm air, one cause of draughts, and to retain heat. The heater should be switched on a few hours before farrowing begins, and any saving in electricity made when the piglets are older and strong enough to do without artificial heat. It is a common failing to leave the heater on until the piglets are due for weaning, when it could with advantage be switched off 2-3 weeks earlier. Piglets tend to become soft if kept too long under artificial heat, especially if the lamp is too near the floor. It should be about 18 inches above the floor at first and gradually raised to 2-2½ feet.

The sow should not remain in this confined space too long, only 3-4 days, and should be let out for exercise each day during this period. If the sow and litter are not being moved to new quarters after 3-4 days she should be given free access to the larger portion of the farrowing pen and the dunging passage. A small board placed across the bottom of the doorway to the dunging passage will prevent young piglets from straying and becoming wet and chilled but will not hinder the sow's movements.

Creep feeding is essential to maintain a steady and satisfactory growth, and a suitable feed should be offered at a week to ten days old. This can be a

meal mixture or pellets, the latter being very acceptable to young pigs and usually less wasteful. It should be placed in a low trough within the area restricted to the piglets and as far away from the heater as possible. A handful or two is sufficient at first but the aim should be to get them eating about 2 lb per head per day at eight weeks. A little brown sugar scattered over the creep feed during the initial stages is a great incentive and tempts the piglets to start eating.

Some common causes of loss

Overlaying accounts for the majority of losses amongst piglets during the first week, but the proper use of a modern farrowing pen can reduce these to a negligible number. Starvation due to shortage of milk is another cause, and may be due to mastitis, which can be controlled by veterinary treatment. Anaemia is a common trouble, especially among piglets reared indoors. Preventive measures have been developed and routine dosing with iron will overcome anaemia, but it is essential to dose early and to repeat if necessary. The effects of anaemia are much worse when the piglets are cold and wet.

E. coli infections can be very troublesome, but it should be borne in mind that good husbandry is an insurance against many troubles and a high standard of cleanliness is essential, especially in the farrowing quarters. It is also good practice to wash the belly of the sow thoroughly with warm water containing five per cent of washing soda a day to two before her litter is due. And it may not always be realized that pigs respond to gentle handling and kind treatment. An occasional grooming can be a great help and yield results out of all proportion to the time spent on it.

Theory and Practice of Poultry Genetics

R. OSBORNE, M.A., PH.D., F.R.S.E.

Research Director, Hall-Mark Hatcheries Ltd., Wickford, Essex

The factors of inheritance must be understood and marshalled to give us the kind of birds we want.

UNTIL the end of the nineteenth century the prevailing view of inheritance was one of blending, with an inseparable fusion in the offspring of parental characteristics. Vague terms such as "reversion" and "atavism" were invoked to recognize the reappearance of ancestral characteristics, but serious doubts were felt regarding the prospects for selective breeding and the validity of Darwinian evolution. Both demand the continued presence of variation, which would, however, be eliminated rapidly by blending inheritance.

Re-discovery of the Mendelian theory at the turn of the century revealed that inherited factors do not lose their identity and, though not necessarily outwardly expressed, are readily transmitted to subsequent generations. Thus a rose-combed chicken hybrid may contain factors R and r for rose comb and single comb, R being dominant or suppressing the effect of r. Reproductive

cells formed by the hybrids contain only one of R or r, and mating amongst them results in new combinations RR, Rr and rr in the progeny. RR and Rr are rose combed whilst rr is single, so that segregation of Mendelian genes provides a mechanism for preserving variation and a vehicle for progress from selective breeding.

Physical bodies, the chromosomes, existing singly in reproductive cells but paired after fertilization, were soon identified as the material carriers of Mendel's hypothetical units of inheritance. His thesis was confirmed and elaborated for many traits including physical characteristics of poultry, the mechanism of sex determination was established, and the foundation was laid for such commercially useful principles as sexing chicks on colour differences.

Traits studied were, however, divisible into distinct categories such as black and white. Distinct genes were identified with distinct groups, and it seemed inconceivable that Mendelian inheritance should determine the continuous type of variation, showing no distinct classifications, typical of such quantitative traits as human stature or egg production in chickens. Yet Galton and other English statisticians had shown significant correlations between parent and offspring for such traits, and controversy raged as to whether Mendelism was general, and conversely as to whether quantitative traits were really inherited. Two major developments took place before, in 1918-20, Fisher[1] in Britain and Wright[2] in the U.S.A. presented mathematical analyses in which Mendelism and quantitative inheritance were treated as parts of a harmonious whole.

In 1909 Johannsen[3] showed that whilst genetic factors were responsible for large differences in seed size between selected lines of beans, inbred lines gave an eventual cessation of response to selection. Considerable residual variations within lines were only attributable to uncontrollable environmental factors varying from plant to plant. Immediately subsequent work of East[4] and Nilsson-Ehle[5] with plants emphasized the contribution of Mendelian genes and led to the multiple gene hypothesis. Thus extreme red of wheat kernels may result from the presence of three pairs of genes AABBCC. Substitution of a for A, b for B, or c for C gives a slightly paler colour, further changes occur with two or more substitutions and so on down to the opposite extreme aabbcc, which is white. Variation is continuous with few individuals near the extremes but higher and higher frequencies towards the average where intermediates arise through different gene combinations.

This is the apparent situation in production traits of poultry which may obviously depend on many physiological processes, the action of many genes, and the multitude of environmental influences operative from incubation until death. Variation is dependent on the cumulative action of many genes whose individual effects may be small and indistinguishable from each other, whilst variation due to genes may be confounded with that due to environment.

To this day, the foregoing distinctions are not sufficiently appreciated, and the nineteen-twenties and thirties were characterized by unfortunate attempts to solve the inheritance of production traits in terms of single genes. The practical ramifications of Fisher and Wright's analyses were not revealed until 1945 with the publication by Lush[6] and his school of *Animal Breeding Plans* and associated papers, whilst in 1950, Lerner's[7] *Population Genetics and Animal Improvement* marked a first synthesis of theory with actual selection experiments in poultry.

Some present lines of thought

Modern selection techniques are most readily explained with reference to pure breeding, but it will be useful to digress and consider the general structure, if not the details, of progressive breeding organizations.

The traditional production of commercial layers has revolved around pure breeds and first crosses between them. Pedigree master breeders, apart from selling commercial chicks, supply pure breeding stock to lower members of the hierarchy where improvement is often contingent on the mating of bought-in stock to females selected by handling. These breeders in turn produce their own commercial chicks or act as egg suppliers to independent hatcheries. Testing is often limited, closed flocks are exceptional, and performance of the end-product, admittedly frequently outstanding, is rarely the outcome of systematic testing of different strains.

Recently, and particularly by some of the larger hatcheries, there has been a swing to large-scale breeding schemes directed at the systematic exploitation of hybrid vigour. Briefly this means production and general merit over and above that expected from the average performance of parents, and arises when genes existing in the homozygous forms AA and aa in two pure strains are united in the heterozygous form Aa in the progeny. Many such gene pairs may be involved, and outstanding results are contingent on the testing of many combinations employing two-, three- or four-way crosses to introduce further heterozygosity from opposite members of gene pairs Aa, Bb, Cc, etc.

Thus a hypothetical operation may involve the annual reproduction and testing of four strains or closed flocks of White Leghorns, four of Rhodes and four of Light Sussex, some of which will be proven and constituents of the commercial hybrid, others newly introduced for testing. Judicious crossing of strains will be carried out involving 32 combinations between light and heavy breeds alone, and many more as judgment dictates. In addition, maintenance of pure strains is necessary over a period of years, pending commercial acceptance. Testing of crosses internally and in field trials will be directly related to economic profitability; high production of large and standard eggs will be set against feed costs, whilst livability, lack of broodiness, carcass value, and even the size of bird in relation to the desire for high stocking rates will be included as vital criteria of merit.

Given a successful cross AB, the appropriate strains may be multiplied for commercial crossing. Under continued testing and selection, 5,000 birds at the foundation level may provide 25,000 grandparents of the hybrid, whilst these in turn may be multiplied to give 100,000 parent stock on supply farms which return hatching eggs for the production of commercial chicks in terms of millions.

More than likely, however, crosses such as AB will be deficient in some respects. Body size may be too big, indicating the desirability of crossing to a smaller strain. Crosses AB and CD may be satisfactory except for inadequate production in the pure strains, and a four-way cross ABCD may seem desirable for economic hatchery and supply farm production. Further extensive testing is necessary, since hybrid vigour of a cross resulting from heterozygosity Aa may be dissipated by mating back to another strain which will most likely have the same genes in common. Testing of three- and four-way crosses will be judiciously restricted to strains which combine well in first cross combinations or which will independently contribute desirable

traits, but in all cases the number of permutations is great enough to permit considerable improvement in the end-product. Needless to say the task is one demanding considerable resources, with careful experimental design and assessment of the statistical significance of variable results.

Pure strains and their crosses

Pure strain breeding for hybrid production is subject to many improvisations, but recent work by Blyth and Sang[8] confirms the correlation existing between the performance of pure strains and their crosses, whilst the economic desirability of highly productive strains cannot be denied.

Inbreeding may be directed towards uniformity through the fixation of genes in the form AA or aa, with release of heterozygosity Aa on crossing, but the deterioration of inbred lines renders it commercially unattractive. Recent work, as with blood-group genes, also indicates that variability may be permanently maintained through inevitable breeding from heterozygotes Aa which have a higher survival value. Genetic segregation produces continuously the original types AA, Aa and aa.

Reciprocal recurrent selection may be adopted to reproduce each of two pure strains from parents which have been progeny-tested by crossing to the opposite strain, but it should not be applied to the exclusion of testing many strains in different crosses and identifying those in which desirable complementary genes are fixed. In addition, care must be taken not to emphasize cross-bred merit to the exclusion of the undoubted gains from exhaustive progeny testing and family selection within pure strains.

Pure-bred selection may be directly towards improvement of particular traits, though the possibility exists of so disrupting gene frequencies that the ability to combine with other strains may be destroyed. Here continued test crossing with other members of the hybrid combination is essential. Alternatively, selection may be towards intermediate values which sub-samples of the strain crosses have revealed as optimum. In either case emphasis must be placed on family selection and progeny testing aided, where possible, by refined statistical techniques.

Due to environmental influences, individual performance of a bird cannot be identified with breeding value. High performance may result from favourable genes, but favourable environment may boost it above that expected under less favourable conditions. Progeny of such birds are exposed to an array of environmental influences good and bad, and their average performance falls markedly below that of selected parents. Thus selection of birds laying 250 eggs from a flock averaging 150 may give progeny averaging only 155. The selective gain of 5 eggs in 100 corresponds to a low heritability of 5 per cent.

On the other hand, a family of full or half-sisters is exposed to a larger array of environmental influences. Environment is more nearly equal from family to family, and average differences between them are more truly genetic. Differences between families are not nearly as marked as between individuals, but they are more readily reproduced. Theoretical and practical studies show that where heritability is low—as for egg production, livability and hatchability—selection on the basis of family average alone is more efficient than selection on individual performance. For egg and body size the reverse is true; individual merit can be more closely identified with genetic

Certain protective coatings on steel, such as zinc, act in two ways: firstly, they are very much less corrodable than steel and, secondly, even when they have gone in local spots, the residue will afford galvanic protection to the underlying steel. It is to be appreciated that the ultimate protection and life afforded by a zinc coating, for example, will depend on the total thickness of the coating, and this is obviously a measure of the quality of the product, be it galvanized sheet or electrozinced wire. Metallic coatings such as zinc applied by hot dipping, metal spraying or electrodeposition will, if applied in thick enough layers, give many years' protection.

Other protective coatings for corrodable metals include paints of many and various types, which are regarded as "durable", and also a whole range of so-called "temporary" protectives ranging in character from a thin film of oil to something approaching the permanency of a paint film. One vital issue is at stake in considering the possible life of any such protective coating and that is the nature of the surface to which it is to be applied. It is essential that the steel is both clean and dry, and possibly this is the most difficult task of all to accomplish. Some types of paint may be a little more tolerant of an indifferently cleaned surface than others, but one which is fool-proof to all the muck and grime of the farmyard has yet to be discovered! Pretreatment of the steel surface to be painted by phosphating or some allied process enhances greatly the life of paint films subsequently applied, but this is usually possible only at the manufacturer's plant. Writing of "clean and dry" as a prerequisite for painting brings to mind the essentials for the treatment of the relatively uncorrodable components of equipment used for handling or spraying fertilizers, selective weed-killers and other dressings or liquids. The term "relatively" is to be stressed in this context, for woe betide the man who neglects to swill away with clean water all remnants and debris of these most aggressive materials.

The possibilities for the wider application of the temporary protectives merit very much further consideration for equipment and machinery in the farming industry. Usage periods may be limited, and there are long periods of weeks or months when these items lay idle, perhaps in the worst of corrosive environments, and then they may deteriorate very quickly. Much development work has gone into the exploitation of these protectives by the large oil companies, and it seems very appropriate for the farming community in particular to take advantage of the available materials. Such temporary protectives include compositions which can be brushed, sprayed or dipped to give films of various types and thicknesses. Some of these materials will actually displace water from the metal surface and can be used in conjunction with a heavier protective material.

In concluding this all too brief survey of a particularly vast subject, it is wise to reflect on the fact that the farmer can do much, in relatively simple ways, to combat corrosion and deterioration in his plant and equipment. The savings to be made by such considerations are really substantial, and wisdom in planning and executing lines of defence will yield good dividends.

Better Barley

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A short account of the work being done at the Plant Breeding Institute to produce better barley, including news of some exciting developments.

During the last ten years the barley crop has continued to occupy an ever-increasing place of importance in the agriculture of the United Kingdom, and there has been an increase in the acreage of over 50 per cent since 1952. The area under barley for the 1961 harvest will undoubtedly be more than 3 million acres, the largest ever in this country. It is significant that most of this expansion has taken place during the last five years, and has been accompanied by a greatly increased production, because yields have also been steadily rising. Thus in 1953, with yields averaging 22·7 cwt per acre, the production in the United Kingdom was 2½ million tons, and in 1959 and 1960 production was over 4 million tons, with yields of 26·3 and 24 cwt respectively.

This remarkable change in barley growing has obviously to be taken into consideration by the plant breeder, who must be intimately concerned with the major agricultural and economic trends in the crops he is handling. The great expansion in the barley crop is the result of Government action to encourage self-sufficiency in feed grain, and barley has become a better proposition in many parts of the country than oats. If there is a 4¼ million ton crop this year, it is calculated that about 3 million tons will be sold off the farm, of which 1 million will be utilized for malting and distilling. Apart from a ¼ million tons for seed, and the small amounts that may be exported, the rest of the crop will be used for feed, including the requirements of the compound feedingstuffs industry.

Although the malting and brewing market continues to attract most barley growers, the bulk of the crop is obviously destined for feed. This immediately raises the question as to how far most growers are justified in trying to meet the requirements of the malting barley trade, and there has been a tendency for more thought to be paid to growing for feed. Are the most suitable varieties available for feed as opposed to malting, or can the present varieties be used for both purposes? The problem is certainly one which the plant breeder must ponder, and decide whether his programme of work meets the situation or needs to be changed.

For some years now, the barley breeding work at Cambridge has been taking into consideration these important developments and changes in barley growing and usage, while the varieties recommended by the N.I.A.B. for cultivation in this country have also appreciated the position in naming varieties suited for malting and for feeding purposes respectively. The new varieties that have become available within the last ten years have undeniably gone a considerable way to meeting the different requirements. For example, it has been calculated that during the later nineteen–fifties the rapid increase in the acreage under Proctor was largely responsible for increasing the national average from year to year. But Proctor is essentially a malting

barley, and although it set new standards in combining high quality and high yield, it cannot be regarded as the most suitable variety for those who require the highest yield in terms of feed. For this purpose, Herta or Rika are undoubtedly preferable in certain conditions, because of their stronger straw and rather earlier ripening.

With the general objective, therefore, of improving the yield of varieties both for malting and for feeding purposes, several separate lines of research have been developed at Cambridge. Apart from yield, there is a widespread desire for earlier maturing varieties, while there is undoubted scope for breeding varieties with better regional adaptation. The characters concerned are all bound up with yield, of course, but they have to be considered separately—resistance to drought, disease, shattering and shedding; winter-hardiness and, of course, strength of straw. These virtues are components of yield, but it is the relative expression of each that gives a variety its characteristic features and makes it more adapted to certain conditions of cultivation than others.

Potential replacement for Proctor

The most advanced material being handled at the Institute is in the category of spring malting types, and two new hybrids are being multiplied for release to farmers from the harvest of 1962. One of these hybrids, obtained from the cross Spratt-Archer × Freja, ripens approximately five days before Proctor, and it is hoped will do something to meet the demands for an earlier barley of good malting quality. The other is the first variety of malting barley bred in this country that shows a high level of resistance to mildew, and is in fact more resistant than Continental resistant varieties such as Union and Wisa that have become available in this country in recent years. The lodging resistance of this new hybrid is better than that of Proctor, and it can be regarded as a potential replacement of that variety. Plot and field trials have shown that mildew resistance can help greatly to stabilize yields, as under conditions of severe mildew attack losses may be as high as 15 per cent. Indeed, in some small-scale trials in Yorkshire, new mildew-resistant hybrids have outyielded Proctor by considerably greater amounts. This being so, two further mildew-resistant hybrids, derived from a similar parentage as the one to be marketed, are now in N.I.A.B. trials. One of these is earlier-ripening than Proctor and therefore represents an improvement in two important characters.

These new spring hybrids show advances in different directions—resistance to lodging, earliness and mildew resistance—as far as field characters are concerned, and there is no doubt that continued improvement is possible not only in the expression of individual characters, but also in more valuable associations of them. The closer and more exact analytical study of malting quality is indicating ways in which this character may be improved, however, and it is anticipated that Proctor-type quality may be improved upon. Exhaustive testing of the separate components of malting quality, including the expression of dormancy and of germination behaviour, is leading to a better understanding of how improvements may be achieved by the use of laboratory micro-malting techniques which have recently been developed and are currently being improved.

Winter malting types

Similar general considerations hold for the improvement of winter malting barleys but, of course, there are special matters for attention for barleys of this type. Efforts have been made during the last ten years to breed a replacement for Pioneer, and a wide range of hybrids has been studied. As a result three new hybrids are now in N.I.A.B. trials; these are derived from a Proctor-Pioneer cross and they are Proctor-type, but with winter-hardiness. They are earlier maturing than Pioneer, and can be grown successfully from normal spring sowings, while in some trials they have given considerably higher yields than Pioneer. However, it is realized that it is necessary to improve the winter-hardiness of these hybrids to make autumn sowing really safe, so a new range of crosses is being handled using new sources of winter-hardiness. The most advanced of these hybrids show a definite improvement in combining hardiness with other good field characters and with malting quality, while mildew resistance is also being introduced. There is great scope for a major improvement in winter malting barleys, and considerable importance is attached to this objective in the breeding work.

Feed barleys

Although malting quality has been kept to the fore in all parts of the programme so far described, there is no reason to feel that certain aspects of it may not result in sufficient improvement in yield and straw characters to give a barley particularly suitable for growing as feed. This possibility is being kept constantly in mind, but in addition a large part of the more recent crosses is being studied specifically for the isolation of feeding types. A range of crosses involving Proctor, Domen, Rika and a dwarf mutant from Proctor is to be selected this year entirely on yield potential, while other crosses will be added to the programme for developing feeding barleys. Already a short straw six-row winter type suitable for this purpose has been bred, and is in the early stages of multiplication with a view to possible marketing, and this form has been used as a parent in hybridizing with Proctor to produce two-row forms with short, strong straw. The selections from this cross appear to have sufficient promise to justify further hybridization with the short six-row form, and this will be done using the strongest straw two-row varieties available. These crosses can be used to select either spring or winter forms, and also the possibility of developing six-row feed types will be borne in mind if these should show a propensity for higher yield than the two-row selections.

The various aspects of this barley breeding programme will need to pay the closest attention to the future position of barley growing in this country. It is necessary, as in all plant breeding programmes, to be in a position to capitalize as quickly as possible on new requirements by the grower, the consumer and the processor. Breeding objectives are determined by these requirements, and the present position of the barley crop offers great scope to the breeder, for there are considerable improvements which can be effected to make barley growing more efficient.

Continuous Barley Growing

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An account of an experiment, started in 1954, to learn whether undersowing with trefoil will maintain continuous barley growing on the Yorkshire wolds, and to compare this system with a rotation of barley-clover-barley-swedes.

PRESENT trends in farming make it essential to improve efficiency and reduce the costs of production, and this could be done on many farms by simplifying the farming system to keep overhead costs to a minimum. On many larger farms in the south and east of England cereals are the most profitable crop, and at present less profitable crops and stock are often carried to prepare the land for them. If the proportion of cereals could be increased without loss in yield, the less profitable acreage could be reduced, the capital charges involved in cereal growing spread over a larger acreage, and the economic position of the farm improved. This is not, of course, a new problem or a new approach to it, as Chamberlain has farmed in Oxfordshire since the early years of this century on a system involving no livestock and containing a very high proportion of cereals. His system was described in this *Journal* in December, 1947*.

Undersowing with trefoil compared with rotation

There is, however, very little critical evidence on the yields likely to be obtained from continuous barley growing, or on the value of undersowing with trefoil in such a system. (It will be remembered that by undersowing with trefoil in the Chamberlain system it was hoped to reduce the incidence of take-all, to limit weed growth and help maintain soil fertility.) To get more information on this subject an experiment was started in 1954 on chalk soil at High Mowthorpe Experimental Husbandry Farm on the Yorkshire Wolds, in which plots on four treatments were drilled with barley every year. On one of these treatments the barley was never undersown; on another it was undersown with 10lb trefoil every year; on the other two it was undersown in alternate years—one plot being undersown in each year. All the plots on these treatments were grown at two levels of nitrogen, 15 and 45 units of nitrogen per acre—which may appear low by modern standards—and also a comparison was made of the effects of ploughing in the straw on some plots and carting it off others. As a control, a further set of plots were included which were farmed on a four course rotation of barley—red clover—barley—swedes. This was designed only to produce barley reasonably free from disease, and with yields which could be compared with those from the other, more drastic treatments. The barley crops on this rotation were given 15 units of nitrogen per acre—the lower of the two levels given to the continuous barley crops. All the barley in the experiment received the same dressing of phosphate and potash; the swedes in the rotation received a dressing of complete fertilizer equivalent to 1 cwt sulphate of ammonia, 3 cwt superphosphate and 1 cwt

*Farming without Stock. R. Sylvester. *Agriculture*, 1947, **54**, 422-4.

muriate of potash and were always carted off, and the red clover received no fertilizing and was cut and carted off.

Before dealing with the effects of the treatment on crop yield it is worth mentioning some of the practical difficulties met during the work. The greatest of these was weed control. In the early years of the experiment the MCPB type of spray was not available and, as it would not have been safe to spray the plots undersown with trefoil with MCPA, no form of chemical weed control was used before 1958. This resulted in the plots becoming very foul and the growth of the undersown trefoil being checked by weeds, but from 1958 onwards MCPB sprays were used and enabled the trefoil to make better growth. They did not of course control couch grass. This also became a major problem and could not be satisfactorily tackled by cultivation, owing to the inclusion of red clover in the four-course rotation and to a lesser extent to the undersown trefoil. This problem was also overcome in the autumn of 1958 by spraying with a dalapon compound and by modifying the cultivation techniques. Weed control is obviously a problem of continuous barley growing which must be faced, but one which appears to be controllable by modern spraying techniques combined with thorough and timely cultivations.

Effects of the treatments

The effects of the treatments for the six harvests 1955-60 are summarized in the table below.

Continuous Barley Experiment
Mean yields over years 1955-1960
Grain at 85 per cent dry matter: cwt per acre

	Arable rotation		Barley every year			
				Undersown in alternate years		
	Barley after: Swedes	Barley after: Clover	Not Undersown	Undersown in previous year	Undersown in current year	Undersown every year
	(± 0·70)		(± 0·49)			
Low N 15 units per acre	28·0	31·3	19·7	22·3	19·9	20·7
High N 45 units per acre	—	—	26·3	27·5	26·6	27·7
MEAN	29·6 (± 0·49)		23.0	24·9 (± 0·35)	23·2	24·2

No figures are given for the effects of the straw treatments, as yields were identical whether the straw was carted off or ploughed in. These results are completely in line with those obtained in the straw disposal experiment which is also being carried out in the same field. The most interesting result has been the effect on yield of the different levels of nitrogen. At the lower level of nitrogen (15 units per acre) the continuous barley has yielded 9-10 cwt per acre less than that on the four course rotation, but when the higher level (45 units per acre) was used the differences in yield were very much less. These crops have been carefully examined every year by the N.A.A.S. Regional Plant Pathologists, who have never been able to find an appreciable amount of disease on any plot. Under these possibly surprising circumstances the level of nitrogenous fertilizing appears to have had the main effect on yield.

If these results are examined in greater detail, we find that the barley on the continuous plots receiving high nitrogen has in most years yielded as well as the barley after swedes in the four course rotation, and the higher yield from that rotation is due primarily to the yields of the barley after clover, which presumably benefited from the nitrogen fixed by that crop. It is likely that the total amount of nitrogen available to this barley was higher than that given to the high nitrogen continuous barley plots.

Under these conditions, when little disease has been present, undersowing with trefoil has had little benefit on yield. The plots undersown every year and those undersown in the previous year have given approximately 1 cwt more grain per acre than the other treatments, but this increase is not enough to cover the cost of the seed and the trouble involved. The difference between the yields from the barley undersown in the previous year and that undersown in the current year suggests that the effect of this treatment is probably due to the nitrogen which becomes available when the trefoil is ploughed in.

Falling response to nitrogen

The information given by this experiment is unfortunately rather incomplete, but it does suggest that barley can be grown for year after year on the same land and still give satisfactory yields provided that adequate levels of nitrogen are given and the initial level of disease is low. There is, however, some evidence that the response in yield from each unit of nitrogen in this experiment is now slightly lower than that being recorded in other experiments on the farm—suggesting that as the run of barley crops lengthens more and more nitrogen may be necessary to maintain adequate yields. It is hoped that the experiment will be modified shortly to cover these points and bring the levels of fertilizer used nearer to modern practice. On the question of undersowing, the results obtained to date have given little information as to the effect of this practice in controlling take-all, as the barley on all plots has remained free from the disease. If undersowing is not beneficial in controlling disease, however, it has little else to recommend it. It costs money, is an extra job to do in the spring and, if the trefoil is to be allowed to grow up after harvest, means that the land cannot be thoroughly cultivated in the autumn to control perennial weeds.

★ NEXT MONTH ★

Some articles of outstanding interest

BORROWING MONEY *by A. R. Collingwood*

DEVELOPMENTS IN SEED TESTING *by P. S. Wellington*

ORGANIZATION OF FIELD WORK *by G. H. Brayshaw*

VEAL PRODUCTION *by K. W. G. Shillam*

Winter Cereal Varieties

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THE following notes summarize the chief characteristics of the winter cereal varieties officially recommended by the National Institute of Agricultural Botany. They are intended for growers who wish to make an early choice from varieties of proved value, and although some sixty newer winter cereal varieties are being tested by the N.I.A.B. this year, no attempt is made here to anticipate the trial results.

Winter wheats

In the tables below and on p. 252 the varieties are arranged in order of expected yields. High figures indicate that the variety shows the character to a high degree.

Recommended List of Winter Wheats

AGRICULTURAL CHARACTERS:	Professeur Marchal G (N)	Cappelle-Desprez G	Flamingo G (N)	Minister O	Hybrid 46 G
Standing power	6½	7	7	7	8
Shortness of straw	6½	7	4	6	7
Resistance to shedding	5	7	7	5	6
Resistance to sprouting	6	7	3	2	5
Resistance to yellow rust	7	5	5	9	9
Resistance to loose smut	9	2	6	7	2
Resistance to mildew	6	7	7	6	7
Earliness of ripening	8	8	8	8	7½
Suitability for late sowing (early February)	6	7	4	7	7
QUALITY OF GRAIN:					
Milling quality	5	5	3	6	4
Bread-making quality	4	5	3	5	4
Biscuit-making quality	6	4	8	7	6

AGRICULTURAL CHARACTERS:	Elite Lepeuple G (N)	Banco O	N.59 S	Domi-nator O	Mil-fast O
Standing power	6½	6	6	6	7
Shortness of straw	6	4	3½	6	6½
Resistance to shedding	8	6	7	8	7
Resistance to sprouting	6	6	6	7	7
Resistance to yellow rust	7	5	8	7½	5
Resistance to loose smut	7	9	4	9	7
Resistance to mildew	7½	8	7	7½	7
Earliness of ripening	7½	4	7	9	9
Suitability for late sowing (early February)	8	2	8	7	7
QUALITY OF GRAIN:					
Milling quality	9	7	7	9	9
Bread-making quality	7	7	4	7	9
Biscuit-making quality	4	2	3	4	2

G = General use.
S = Special use.
O = Becoming outclassed.
(N) = New recommendation.

Professeur Marchal is outstanding for its heavy yield and has proved fairly consistently superior to Cappelle-Desprez in this respect. It is, however, not quite as stiff in the straw as the latter variety and does not possess the same resistance to eyespot. Professeur Marchal shows some promise as a biscuit wheat; although a "hard" wheat it is not in general superior to Cappelle-Desprez in milling quality and the skin in some samples is rather rough.

Cappelle-Desprez remains a useful wheat for a wide range of conditions, and its good resistance to eyespot particularly commends its use in rotations where heavy white-straw cropping encourages the prevalence of this soil-borne fungus. Although formerly considered resistant to loose smut, many stocks have become seriously infected in recent years, and care should be taken to obtain "field approved" or other reasonably healthy seed.

Flamingo has outclassed Minister as a white wheat suitable for biscuit-making. Its yield is similar to Cappelle-Desprez, as also is its straw stiffness in spite of its greater length. Like all white-grain wheats it is susceptible to sprouting in wet harvest conditions. Some stocks have contained varying amounts of red grain, and seed should be bought only from a reliable source.

Hybrid 46 remains the stiffest strawed of the recommended wheats and has proved reliable on land which is subject to manganese deficiency.

Elite Lepeuple provides perhaps the best combination of good yield with high grain quality, and is to a large extent an "alternative" wheat which can also be used for early spring sowing.

N.59 has given its best yields in the north, and its fairly long but stiff straw has been used successfully for thatching.

The remaining three varieties are in the category "becoming outclassed". They are all of high grain quality but are relatively low yielding. Banco is the latest in ripening of the recommended varieties and is very winter-hardy, while Dominator and Milfast are the earliest varieties, the latter having short stiff straw.

Winter oats

Recommended List of Winter Oats

AGRICULTURAL CHARACTERS:	Penrhyn G (N)	Powys G	Pennant G (N)	S.147 O	Barnwell G (N)	S.172 G
Standing power	5	7	6	5	7½	9
Shortness of straw	4	6½	6	3	6	9
Yield of straw	6	5½	5½	6	5½	5
Winter-hardiness	6½	7	7	7	7	7½
Resistance to mildew	7	6	5	5½	5½	4
Resistant to stem eelworm			*		*	*
Earliness of ripening	4	7	6½	6	4½	5
QUALITY OF GRAIN:						
Kernel content	7	7½	7	7½	7½	7
Size	7½	5½	8	8	5½	5

Penrhyn is the highest yielding winter oat on the present Recommended List. Its straw, however, is only similar in strength to S.147 and the variety is by a small margin the latest in ripening of the recommended varieties.

Powys lies in yield between Penrhyn and S.147, but its straw is stronger than either. It is thus a useful successor to S.147 for general purposes, and the latter variety is now considered outclassed.

S.172 remains the stiffest-strawed variety, and trials have shown that in many years its average yield is only slightly lower than that of S.147. Unlike the other varieties so far mentioned S.172 has very good resistance to oat stem eelworm.

For the 1960 season two new oat stem eelworm-resistant varieties were added to the List, namely Barnwell and Pennant. They may be regarded as being broadly similar in field characteristics to Powys but of special value on fields where there is a known history of eelworm occurrence. Compared with Powys in trials to date Barnwell has been somewhat lower yielding but stiffer, while Pennant has been very slightly higher yielding but weaker.

Winter barley

Pioneer remains the only recommended winter barley. Spring varieties are sometimes used for autumn or winter sowing but are not resistant to very severe frost.

Further information on these and on newer varieties can be obtained by writing to the National Institute of Agricultural Botany, Huntingdon Road, Cambridge, or through the National Agricultural Advisory Service.

CALF SUBSIDY

The present calf subsidy schemes enable subsidy to be paid in the United Kingdom only on calves born up to and including 29th October 1961. The Government has decided to continue the subsidy on calves born subsequently and has laid before Parliament Orders providing for payment of the subsidy for a further three years—the maximum period for which a particular scheme under the Act can be made. All eligible calves born up to and including 29th October 1964 will, therefore, qualify for the subsidy.

The subsidy will continue generally on its present basis for steer calves and heifer calves of beef type. But the special concession whereby calves born in February, March or April in certain hill and upland areas may be inspected for the subsidy when six months old instead of the usual eight months will be extended to include calves born in May. This will apply for calves presented for certification this year.

Cucumbers

P. G. ALLEN, N.D.H. (HONS.)
Lee Valley Experimental Horticulture Station, Hoddesdon

Mr. Allen discusses the preliminary results of some experiments on bed composition, watering, temperature needs and new varieties.

THE growing of cucumbers is a well-established and highly-skilled industry, covering about 466 acres in England and Wales. Of this total, 307 acres are in Essex, Herts and Middlesex, including the concentrated glasshouse area of the Lee Valley. Economically, cucumbers are the third most important protected crop, being exceeded only by tomatoes and mushrooms. The total production is considerable; at least 100 million fruits annually in England and Wales, or more than two per head of the population in these countries. In addition imports from abroad are likely to increase, so British producers must compete effectively in this limited market by obtaining maximum crops of top quality produce at the lowest possible cost.

It is hoped that investigations now being conducted at several centres will help growers to meet the future with confidence. The Glasshouse Crops Research Institute is paying particular attention to the breeding of improved varieties and the control of diseases and pests, including the red spider mite so troublesome in some areas. The Lee Valley Experimental Horticulture Station, by virtue of its position in the main production area, is also investigating some of the more important aspects of cucumber production. This programme includes work on bed composition, water application, temperature requirements, training techniques and the testing of new varieties and strains. Several experiments have been in hand since 1958 and, although it is generally too early to draw final conclusions, certain trends are becoming apparent. Some of these are examined below.

Varieties

During the first decade of this century when blotch (*Cercospora melonis*) was causing heavy losses, the variety Butcher's Disease Resister (B.D.R.) was obtained from two resistant plants and is now the most widely grown.

Until recently the number of varieties had remained static for many years, but a range of new hybrids is now becoming available. Breeders on the Continent are endeavouring to produce varieties which will crop early with cucumbers of improved shape, without the tendency to become "waisted" during short days or in poor light. Emphasis is also being placed upon resistance to bitterness, and to various diseases, including gummosis and blotch. Unfortunately many of these hybrids yield fruits which are either smooth or with only a few spines, whereas most English wholesale markets are accustomed to receiving very spiny cucumbers and it may not be easy to overcome the feeling that fruits with a few spines are stale or over mature. Several hybrids are now being tested at the Lee Valley Station, and these include Green Spot Hybrid and Market Cross, which have yielded very similar total crops to B.D.R. Over a trial period of two years, they were found to be earlier,

yielding up to 10 per cent more fruits in the first month. Green Spot Hybrid grows quickly and maintains its vigour throughout the season. In 1960, it produced larger cucumbers than B.D.R., but there has been no difference in size so far this year. Some fruits have shorter necks, but they have fewer spines and tend to have a coarser appearance. Nevertheless this variety, resistant to gummosis, can be particularly helpful on nurseries where the disease is prevalent. Market Cross produces fruits of good shape and of very similar size to B.D.R., but sometimes in midsummer they can become rather pale.

L. A. Darby, of the Glasshouse Crops Research Institute, is attempting to raise hybrids with fruits of similar character to B.D.R. but without the long neck that sometimes occurs. One has been tested for two years and has compared satisfactorily with B.D.R. for quality, shape, number of spines and total crop. But the neck is not materially better; it seems to be most difficult to combine all the other desirable features with a short neck. This work is continuing, and a variety with all these characteristics may eventually be obtained.

Several other hybrids and selections from abroad, including types with smaller fruits of even size, appear to be promising, but it is too early to comment on their performance.

One of the most interesting developments is the attempt by breeders to produce hybrids that bear female flowers almost exclusively. Although this work is not sufficiently advanced for varieties to be made available for testing, it is being watched most carefully, for if successful it could obviate the necessity to screen ventilators to prevent bees entering the glasshouses, pollinating the flowers and so leading to unsaleable, large seeded and bulbous fruits.

Temperature requirements

The temperature requirements of cucumbers are being studied in a glasshouse divided into compartments. Four varieties are being grown from the time of planting at night temperatures ranging from 63 to 70°F. Results to date show that early yield is not increased by raising the temperature from 67 to 70°F and there is no effect on total yield; heating costs are materially higher without any compensating greater financial return. The lowest temperature of 63°F significantly reduces the yield in the first month but the overall total is very similar to the other treatments. This work is continuing, and it is hoped that in due course the results will show the optimum economic temperature to give the best early and total yield. The ideal would be to breed a cucumber that would respond most satisfactorily at a temperature at least 5°F lower than that found suitable for the present types, so the more promising new hybrids will be screened at a range of temperatures as they come forward.

Irrigation

In co-operation with staff of the National Institute of Agricultural Engineering, methods of applying water have been examined. Several types of irrigation line, either manually operated or controlled automatically by tensiostats, have proved equally successful. The tensiostat consists of a porous element placed transversely in the bed between two plants and

connected to a vacuum switch, which actuates a solenoid valve when the soil moisture tension reaches a pre-determined level—seven centimetres of mercury in this case. Water is then applied until it penetrates to the porous element, causing the vacuum switch to shut the solenoid valve. Consistent results have been obtained over several years and the following summary for 1959 shows the general picture.

Table 1
Mean yield per plot

Treatment	*Number*	*Weight*	*Market Grades*					*Crooked fruits*	*Water applied Inches**
		lb	10	12	14	16	18		
			per cent						
Hose watering (manual)	854	803	2·6	16·8	27·6	18·0	17·0	18·0	18·1
Adapted trickle line (automatic)	839	796	3·8	22·0	25·3	15·2	15·3	18·3	10·4
Diffuser nozzles (automatic)	830	786	2·8	20.9	26·2	15·9	15·7	18·4	9·2

*Water applied 26th February—mid-August and calculated on total glasshouse area.

The various methods of applying water had no effect on earliness, size or quality, but it is interesting to note the large difference in total quantity of water applied by the hose and automatic treatments in 1959. There were no signs that watering had been excessive on the hose-watered plots, but it seems to have been in excess of plant requirements. On poorly-drained land, this additional water might produce waterlogged conditions in the soil beneath the beds, but on well-drained land where the beds and the soil beneath have a high concentration of salts, it would be an advantage to keep the soil moisture level near to field capacity.

The use of irrigation lines, which can be installed at varying costs (but they should not exceed £550 per acre), can save much labour, and if controlled automatically would not be subject to the skill of the individual worker.

Another method of automatic control, not dependent upon careful placement of an instrument in the bed for accurate assessment of water requirements, is now being tried and a further investigation is in progress to ascertain the most suitable watering tension or frequency.

Bed composition

New turf loam and horse manure are generally acknowledged to be the best media for constructing cucumber beds, but unfortunately a reliable and consistent supply of loam at an economic price is not always available. In some areas horse manure may also be extremely costly and difficult to obtain in sufficient quantity. Growers have therefore tried a number of alternatives, and it has been found possible to grow good crops on a wide range of compositions.

To compare their merits, an experiment was begun in 1958 with various types of bed grouped together under similar conditions in one glasshouse. Bed composition must be considered together with other factors which may have some bearing on cost, yield, and general suitability of the materials when used under the differing conditions found on individual nurseries. Thus, size of bed, methods of construction and the effect of restricting or permitting root action in the soil beneath the beds have been included in the treatments.

In this investigation beds of unsterilized new turf loam and horse manure have consistently produced the heaviest total yields, but steam-sterilized old cucumber bed and horse manure have proved very satisfactory, with only slightly lower yields. Any difference has been largely offset by the increased cost of the former materials, amounting to £150-230 per acre for the sizes of bed adopted. It must be remembered that the "old cucumber bed" material is not old by normal Lee Valley nursery standards, as in 1960 it was only growing its fourth crop following steam sterilization for the third time. However, the original loam had a low organic matter content, and loss of structure after steam sterilization has resulted in a bed difficult to maintain in a well aerated condition. This type of bed is less easy to manage early in the season, as any excess water applied is more difficult to drain off owing to the poorer physical structure. A quantity of sharp aggregate was incorporated in some beds in 1960 in an attempt to improve the texture, but it did not have any significant effect on yield.

John Innes No. 3 potting compost made with unsterilized loam was found to be satisfactory when tried for two years, but it was not better than the two treatments already described and unless heavier yields can be obtained to compensate for the increased cost, there would appear to be no advantage in it. Beds of steam-sterilized old cucumber bed and manure with a cubic capacity of 1½ bushels per foot run would cost approximately £380 per acre, in comparison with £820 per acre for similar-sized beds of JIP3.

Over two years, fresh turf loam and straw compost gave good crops, slightly below the turf loam and horse manure treatments; but unless straw can be bought very cheaply there would not be any economic advantage over horse manure. Generally it is only worthy of consideration when this is not available.

Treated straw bales with a small bed on top or behind have been included in the treatments each year, and are of particular interest on nurseries where it is impossible to maintain yields with old cucumber bed material and where at the same time it is impracticable or uneconomic to replace it by suitable turf loam. This falling off in yield is possibly most noticeable where heavy glasshouse soils are used for making the beds, as the poor texture will bring about a gradual loss of aeration as the season progresses and may cause the crop to be terminated prematurely.

The straw bale beds have yielded good crops, although slightly lighter than the turf loam or old cucumber bed treatments. The difference was most marked in 1960 and the figures for this year are shown in the table of yields on p. 258.

When comparing the yields from the old cucumber bed treatments, remember that the soil is well drained and that high salt concentrations or disease are not a problem in the experimental glasshouse.

Management plays an important part, as in the early stages of growth the bales will dry out more quickly than traditional beds and this must be watched carefully, especially during spells of bright weather. In addition, it may be necessary to begin feeding earlier, and also more frequently at certain periods, if strong productive plants are to be maintained. These two points have received particular attention on the Experimental Station this year, and the yield at the end of three months compares favourably with the other treatments.

Table 2

Experiment on Size and Composition of Cucumber Beds: 1960 Results

Treatment		*Yield—per 20 plants*								*Gross Returns per 20 plants*			
		Total to end of 1st month *lb*	Total to end of 2nd month *lb*	Total to end of 3rd month *lb*	Season's Total *lb*	Flats per foot run	Per cent of 12s	Per cent of 14s	Per cent of crooks	Total to end of 1st month £	Total to end of 2nd month £	Total to end of 3rd month £	Season's Total £
Old cucumber bed + horse manure + aggregate													
Soil base	small*	87	345	512	1,072	1·79	13	26	7	9·4	26	40	65·8
	large†	97	369	534	1,145	1·90	13	25	7	11·3	29	42	71·0
Polythene base	small	79	253	416	951	1·58	16	27	5	8·5	19	31	56·7
	large	113	363	534	1,094	1·82	17	28	6	12·5	28	41	67·4
Old cucumber bed + horse manure													
Soil base	small	84	354	529	1,116	1·86	14	26	8	9·4	27	40	68·7
	large	105	369	550	1,137	1·89	14	25	6	12·2	29	43	70·5
Polythene base	small	91	272	426	936	1·56	17	23	7	9·8	21	32	55·1
	large	129	369	545	1,121	1·87	20	24	6	14·6	30	43	69·6
Turf loam + horse manure													
Soil base	small	99	386	578	1,170	1·95	18	25	7	11·3	30	45	72·1
	large	113	397	572	1,168	1·94	19	27	7	13·3	31	45	73·2
Polythene base	small	111	334	486	1,008	1·68	19	24	6	12·5	26	38	62·1
	large	122	376	555	1,181	1·96	19	28	8	13·9	30	44	72·0
Treated straw bales													
Soil base		106	294	468	1,068	1·78	17	23	8	12·6	25	38	65·6
Polythene base		116	305	461	988	1·64	15	26	6	13·8	25	37	61·7

* Small beds comprised 1 bushel of compost per foot run of bed

† Large beds comprised 3 bushels of compost per foot run of bed

Sowing and Planting Dates

Seeds Sown 15-12-59 Date 1st cut 14-3-60

Planted out 15-2-60 Crop terminated 25-8-60

Cucumber fruits produced with automatic irrigation. The numerous spines are typical of the variety Butcher's Disease Resister.

A glasshouse at the Lee Valley Experimental Horticulture Station divided into three compartments to study the temperature requirements of cucumbers.

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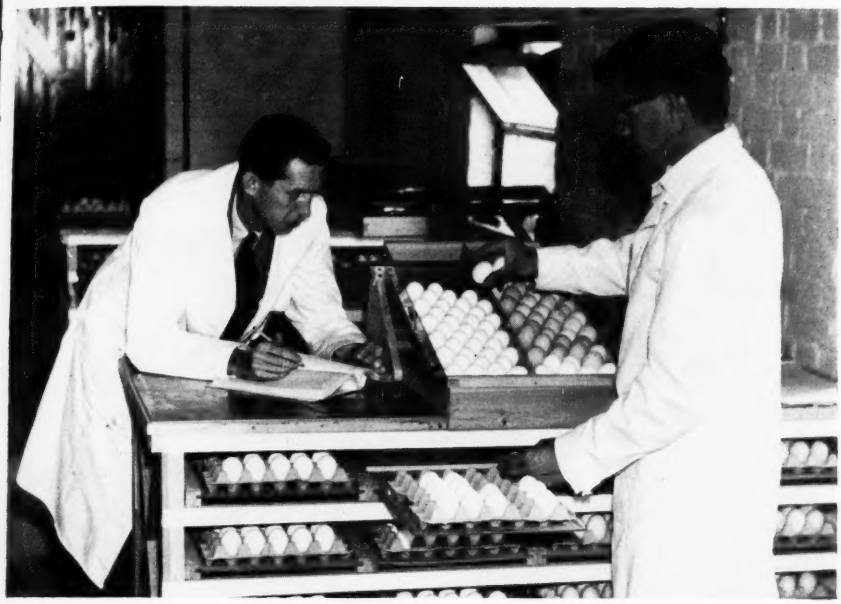
Cucumber fruits produced with automatic irrigation. The numerous spines are typical of the variety Butcher's Disease Resister.

A glasshouse at the Lee Valley Experimental Horticulture Station divided into three compartments to study the temperature requirements of cucumbers.

Interior of one of the progeny-testing houses at Hall-Mark Poultry Research Centre.

Young stock on range before testing for hybrid production.

(Article on pp. 238-42)

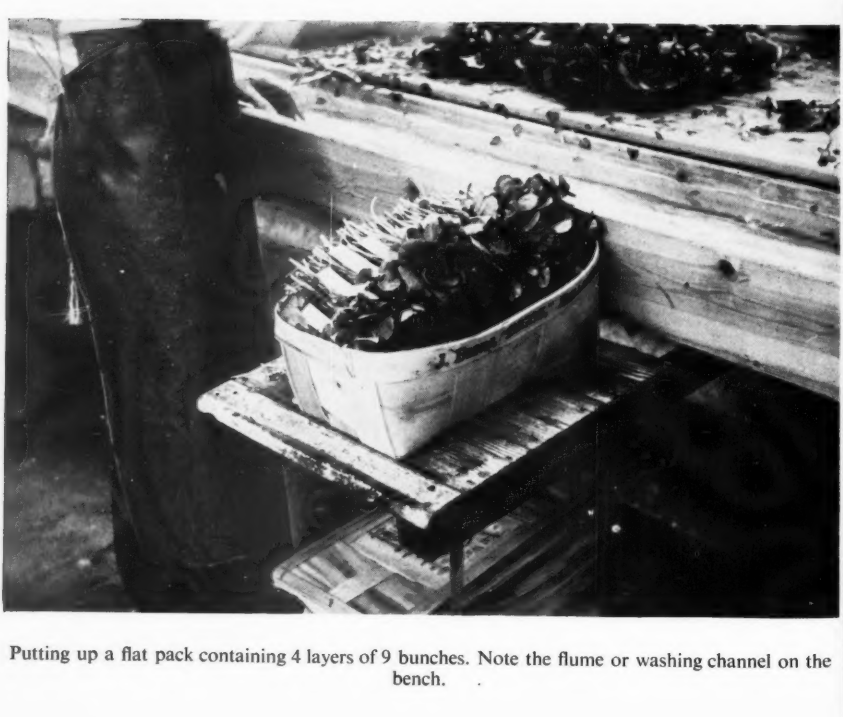


Testing and setting of pedigree eggs for pedigree breeding.

A Multiplication hatchery for distribution of special strains to supply farms.

Handling the Watercress Crop (Article on pp. 260-3)

Pulling over cress in February. About one-third is being removed.



Putting up a flat pack containing 4 layers of 9 bunches. Note the flume or washing channel on the bench.

The price of straw varies considerably according to area and season, so that it is difficult to make a general assessment of cost, but when baled straw can be bought at £5-7 per ton, it is estimated that the cost compares with small beds of turf loam and manure or large beds of sterilized old cucumber bed and manure. Wheat straw is generally used, and the bales should be tied with wire to prevent sudden collapse when the plants are placed on top of them. It is possible to grow the plants on a small bed behind the bales, but a bed on top has proved more satisfactory in a number of ways. The bale will slowly sink, but allowance can be made for this by tying the plants under the first few roof wires and with a slight curve in the stem between the bale and the first wire.

The bales are placed in position in the house about three weeks before planting. Then they are thoroughly damped for a few days, and Nitro-Chalk at the rate of 2 cwt per ton of straw is applied in several dressings and damped in. At the Experimental Station, the inclusion of phosphate and potash has been found beneficial. This can be provided by using a compound fertilizer instead of Nitro-Chalk, but care must be taken to ensure that an equivalent quantity of nitrogen is also given. A small bed of soil and manure or loam and manure can then be placed on top of the bales, and planting can begin when the temperature has fallen to around 100°F and is steady at that level.

Bed size

The study of composition together with bed size is now in its third year, and the results coming forward are most interesting. In 1959, the small beds (1 bushel per foot run) gave a slightly heavier crop irrespective of their composition than the larger beds (1½ bushels per foot run). In 1960, the small beds were of similar size but the large beds were increased to three bushels per foot run to emphasize any possible differences. The small beds on a soil base again produced very similar yields to comparable large beds on a soil base, but at a substantially lower initial cost. Table 2 shows that a very different pattern emerges when the beds are isolated from the soil base beneath. Then the large beds crop at a consistently higher level and very close to that obtained from similar beds placed directly on the soil. Under the conditions of the experiment, with hose watering and liquid feeding, there appears to be a reduction in yield if beds below a certain size are isolated from the base beneath.

In 1960, bed size affected earliness, as the large beds and also the straw bales cropped at a higher level than the small beds during the first month. Thermometers placed in the beds indicated that the large beds were several degrees warmer and the straw bale beds 8-12°F warmer during the whole or part of this period, and this may account for the greater earliness.

Both mixed and layer beds were tried in 1958, and similar results were obtained with the two methods. In view of this, and to release space for other treatments, the comparison was not continued. Layer beds have been used since, as this method was considered to be more common.

Within the scope of this article, it has only been possible to give a broad picture of some of the results, but where additional details are desired reference can be made to the Station Annual Reports, the first of which, combining 1958 and 1959, is now available.

Handling the Watercress Crop

A. F. GARDNER

Ministry of Agriculture, Fisheries and Food

The watercress industry grew up by providing the poor man's salad. The product could have a bright future with a higher social status, combining as it does a very attractive appearance with good qualities as a salad.

WATERCRESS is a perennial plant, but the task of relating supply to the seasonal demand is a challenge to growers almost all the year. Virtually all watercress sold in this country is cultivated, in specially-constructed beds in a few inches of fresh spring water.

The climate in England, with its moderate winters, is generally well suited to the crop, which may be damaged by severe cold or may too readily run to flower in excessive heat. Few other countries grow the crop commercially on any scale, though France is an important producer, and there are no imports into this country. Commercial production originated over a hundred years ago, and was then mainly in the London area. Urban expansion and difficulties in maintaining good water supplies forced the production further afield, firstly to the water-bearing chalk areas of the Home Counties and later to southern counties and to a lesser extent Lincolnshire.

At present there are approximately 360 acres of beds in Dorset, Hampshire and Wiltshire, while the Home Counties have some 160 acres, Surrey and Sussex about 55 acres and in Lincolnshire 40. In all rather more than 700 acres are under this crop in the whole country. There are about 120 growers, who frequently combine watercress with general farming—each grower usually cultivating between 3 and 10 acres of beds. Very few indeed exceed 20 acres.

Although a few growers have their beds in one block, there is sometimes 20 or 30 miles between beds. This is partly due to the difficulty of finding good sites, and partly a result of taking over beds from other growers. New beds are still being constructed, mainly by the larger growers and mostly in the southern counties, but there is a more than corresponding loss of area through the inroads of industrial and other development into both land and water supplies.

Cropping seasons and demand

The grower aims to start the cropping year about the end of August. Supplies are plentiful for about six weeks; cress grows easily at this time, and is in excess of demand until the disappearance of competing salad crops may improve interest in it. Production declines from November with the need to prepare beds for the colder weather. Cress is then put down into the water, where it will continue to grow, if slowly, and will be protected from leaf damage by frost.

During December and January the yield from the beds may vary from practically nil, in severe weather, to moderate in fairly open weather conditions. In the more favoured locations for climate and water, many growers start to increase their gatherings towards the end of January and from then

onwards production increases progressively, except in periods of hard weather, until the peak in late March or early April. Demand during this period is at its greatest—there are few competing salads. Production then contracts during April and May, but some growers aim to continue cropping in the summer until the appearance of flower-heads on the cress makes it unsuitable for sale and slowing demand stops production. During the early summer, beds recover very rapidly and cress may be cut often.

Individual growers have many variations in the pattern of cropping and consequently the availability of cress for sale during the seasons. The cropping programme is determined by such factors as limitation of water supply, its capacity to produce winter cress, the volume of supply, climate, day length, type of cress grown and the market outlets available.

During the winter, the grower may frequently have to decide whether to take the crop from a bed and market it at a good price, or leave it for perhaps a heavier yield but an unknown demand. Thus over the year the number of crops taken from a bed may vary from one to four or five.

Basically, two types of cress are grown, the brown and green leaved types. The former, once widely grown and possessing superior resistance to frost and the ability to grow away early in the year, is now little grown on account of unsatisfactory seed production in most types. There are many strains of green cress with differing behaviour in cold weather, earliness of flowering, leaf size, etc. Growers frequently have their own strains. Green cress of French, Italian and American origin is also extensively grown. This has largely come about through the more ready availability of seed. In recent years varieties with special characteristics have been raised by the National Vegetable Research Station and by some growers. Formerly all cress was propagated vegetatively but following the build-up of virus disease and of crook-root diseases in recent years this method has been largely combined with seed propagation. The important market characteristics in watercress are good leaf colour and size, but most of the other varietal characteristics are recognized by the grower rather than the consumer. Although flavour, for example, varies considerably from one strain to another, only one instance has been noted where this was advertised as a selling point.

Gathering the crop

This task is mostly entrusted to experienced male employees, who usually work for a weekly wage and a bonus on the amount of cress gathered. It is a wholly manual operation. There are two methods—cutting when the crop is growing out of the water in the warmer seasons and pulling from crops growing in the water. The former requires less skill, though cutting the cress too low or at irregular levels may damage or delay subsequent crops.

Standing in the bed or on a plank across it and starting at the top of the bed, the gatherer holds the plant tops in his left hand and cuts with a knife in his right. Usually all the cress is cut, but in some cases only part may be cut, leaving the remainder of the crop to grow on. "Hands" of cress, weighing approximately 2½ lb each, are placed in a container for removal to the packing shed or, less frequently, put in a market container. Gathering by pulling may vary from the taking of a small proportion of the crop, and leaving the rest to grow on, to pulling it all out. The gatherer stands in the water, in rubber boots, and draws out a few plants with an underarm swing,

regularly over the bed—again taking up the hand of cress in his left hand but in this case with the long roots still intact. The cress is moved complete to the packing shed or may be roughly trimmed at the beds.

There are considerable differences in the rate at which cress may be gathered. The equivalent of about 18 baskets of 9 lb each may be cut per hour, but the rate when pulling over may be about 12 baskets, while when pulling out or clearing it may be over 20 in an hour.

Packing

Formerly all cress was sold loose, that is to say packed at the beds in "hands" directly into hampers known as flats and sold by weight to the consumer. This method has largely disappeared, and the demand is now mostly for bunched cress. Some unbunched cress is sold, either for local sale near production areas and also for the restaurant trade: this demand exists largely in the London area. Loose cress is still packed at the beds—the "hands" are placed directly into veneer baskets in an upright position, and these are frequently unlidded. Lettuce crates and a variety of containers are also used for local sale.

Bunching is carried out by hand. A machine has been designed but is not considered an economic proposition. Packing sheds may vary from a wooden hut near the beds to a large modern packing shed operating (in a few instances) on a flow line layout. Hands of cress brought from the beds are placed on the bench from the containers. Women separate them into bunches, judging the size by feel and securing them with rubber bands. Usually a wooden or card strip with the grower's identity or brand is included. The summer bunches weight from 3½-4 oz; in winter, when the cress has a much higher proportion of stem to leaf, bunches are heavier but take up less space.

The task layout in the packing shed will depend on the size and throughput of the operation, but the essential elements are bunching, washing, trimming, packing, lidding, tying, dipping and soaking or hydrocooling. These are separately or jointly performed according to the size of the undertaking. Packing benches are usually fitted with flumes of running water in which the cress is washed before packing. Each buncher's output may be over 300 bunches an hour, depending on the season and the state of the cress. In winter, removal of discoloured leaves by stripping may slow up the operation.

Although various containers have been tried for marketing watercress, the veneer basket equivalent in size to the 12 lb capacity often used for fruit is almost standard. For watercress it is usually made without a handle and is fitted with a veneer lid to protect the cress. Smaller baskets are sometimes packed. Packing is carried out in at least five different ways in the basket. The bunches may be laid flat or upright, 24, 30 or 36 to a basket—the higher number with smaller winter bunches. Baskets when packed weigh from 6 to 9 lb. It is important to keep the cress as fresh as possible throughout its life; for this reason the baskets are usually soaked before packing, and afterwards they are placed in a water tank or under water sprinklers for a few hours before draining and dispatch.

Hydrocooling

Work carried out in 1959 by the Ditton Laboratory established that where cress was placed in water cooled to about 33-35°F for a certain time the

subsequent life of the cress was greatly improved, and that cool storage for 3 days without deterioration was quite practicable for the cooled cress. A few of the larger growers have since installed hydrocoolers for this purpose. In some cases these are fully automatic, and convey the baskets of cress to a tank, submerge them in cooled water for a measured time, spray cooled water over them, lift the baskets from the cooler and deliver them by conveyor into a cool chamber for holding until dispatch.

Hydrocooling enables cress to be gathered over a longer period for the heavier week-end market, and be placed on the market in a fresher condition, particularly by those growers further from the markets. The arrival of hydrocooled cress has generally been well received by buyers. The value of using flaked ice for packing the cress before lidding has also been demonstrated, and is used by one grower.

A lot of cress is carried by passenger train on account of the small size of many consignments sent to each destination. Special rates apply for this traffic from a number of stations. During the peak periods larger growers use road transport to market the larger quantities.

Ideally, cress which has been hydrocooled should travel in insulated transport. This is generally difficult to undertake with small lots, but one firm of salesmen does provide an insulated vehicle for collecting cress from growers' beds.

Outlets and method of sale

Watercress has long been popular in the industrial areas, particularly in the Midlands and the north, and in the London area. For this trade most of it is sent away for sale on commission through the main markets. In the London market a few salesmen specialize in handling cress. One large firm of growers sells all cress by quoting a weekly fixed selling price, while one salesman offers to buy all cress at a price which he quotes to the grower in advance. Orders are placed either way for a fixed number of baskets.

Generally speaking, growers try to market only as much cress as the salesman wants, although occasionally over-supply does necessitate small-scale dumping. In a few instances, growers sell their own cress in wholesale markets, while there is also considerable local sale. In some areas growers deliver to shops in a fairly wide area, normally against firm orders.

Most cress is sold through normal retail greengrocery shops, and the quantities handled in each case are often small. There is some splitting of baskets by wholesalers. Selling of watercress has not yet developed extensively in supermarkets and other self-service shops; in the former the climatic conditions are often ill suited to this produce, being rather warm and dry—the very opposite to the ideal conditions for keeping cress really fresh. Some stores use cooled cabinets, however.

To present cress in really good condition to the public, some growers have provided trays in which it may be displayed in water. This is desirable if an attractive product is to be kept in the best condition.

The growers, who are nationally organized through a specialist branch of the National Farmers' Union, have some forward-thinking men in their ranks and are availing themselves of scientific advances to meet the future.

Electricity and Potato Storage

P. T. G. TWISS, B.Sc. (AGRIC.)

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This account of the part played by electricity in potato storage is concerned mainly with principles. Further information, with practical detail, can be found in a recent publication of the E.D.A.*

THE past ten years have witnessed a quiet revolution in the storage of our most valuable, as well as our least predictable, food crop. Although potatoes —and some other root crops—have been stored in buildings on occasion for many years, no scientific investigation of indoor bulk storage was started until 1946, and not until 1948 was the first scientifically designed store erected. Since then, the method has found favour in the most remarkable way: in 1959, no less than 45 per cent of the ware tonnage actually stored was stored in buildings.

A supply of electricity is not essential for successful indoor ware storage, but its presence certainly promotes ease of management, particularly of late-stored crops. The position with regard to certain methods of indoor seed storage is different. Electricity is not merely convenient for operating a controlled temperature store; for a controlled light store it is virtually essential.

Electricity and seed storage

The principles of management governing the storage of seed potatoes have been described by Thomas and Eyre[1] and by Toosey[2]. If, as is usually the case only one or two sprouts are required on each seed tuber, growth must be induced in the autumn while the seed is still within the single sprouting phase. During this period of its development, the seed tuber is capable of throwing out only one or two sprouts, which thereupon suppress the growth of the remainder—the effect well known as "apical dominance". If growth does not occur during the single sprouting phase—and it will not if the temperature is too low—then too many of the eyes on the tuber will eventually start into growth, giving a plant with too many stems and hence more tubers than can be grown to an economic size. The sprouts formed very early in the season are likely to grow excessively long, however, if not controlled—which requires the provision of light and some means of reducing the temperature of storage to a level appropriate to the amount of light actually provided.

In a properly designed glass building, it should be possible to achieve these aims by sensible traying and stacking, so that each tuber receives its fair share of light, and by adjustment of the ventilators. Usually the temperature in a glasshouse will be high enough during the autumn to cause the seed to grow while still within its single sprouting phase; during the early spring, however, the temperature is likely to become far too high if inadequate provision has been made for ventilation.

*Electricity in Potato Husbandry. *P. T. G. Twiss*. The Electrical Development Association, 2 Savoy Hill, London, W.C.2.

Many potato growers lacking glass chitting houses happen to have redundant buildings of solid construction. A supply of electricity may enable such a building to be converted for the storage of seed potatoes at less capital cost than the provision of a new glasshouse, although this will not always be the case and the comparison is always worth making. In many respects, a building of solid construction is easier to manage than a glasshouse, and this is a consideration which will appeal to many.

How and why of temperature control

An ample supply of light from tubular fluorescent lamps is often thought to be the basic requirement in a windowless chitting house, but this is not really the case. The fundamental need, as with all potato storage, is for adequate control of temperature. The function of light is to prevent unwanted extension growth, while allowing development of root and shoot primordia to continue: if previous management has resulted in multiple sprouting, however, such development is only likely to lead to even more stolons, even more tubers, and an even higher proportion of chats.

A building of substantial construction is quite likely to cool to below the threshold temperature for sprout growth before the seed tubers have passed through their dormant period. If this happens, the tubers will almost certainly have entered the multiple sprouting phase before the temperature in the building is raised through any natural agency to a level at which growth is possible again. It follows that the temperature in the house must be raised artificially, if and when necessary, and this is most easily and economically done by means of thermostatically controlled electric heaters.

Choice of heaters

Heaters should not be chosen solely on the basis of their suitability for this particular duty. Protection from freezing and chilling is of equal importance and the heaters chosen should fulfil both functions. To encourage rapid growth, 50°F is a suitable temperature, and this might mean warming the building some 15 or 20° above the prevailing outside temperature. The same temperature rise should be sufficient to guard against freezing and chilling injury, since it affords protection against outside temperatures down to 14 or 15°F. The actual heating load will depend on the thermal characteristics of the building. A well-insulated building not only requires less heat for frost protection but is less susceptible to changes in outside temperature, which is a good thing. Many converted buildings of light construction would benefit from additional insulation. Both tubular heaters and unit heaters are suitable for use in seed potato stores and either may have the advantage in a particular situation. In general, however, unit heaters are the more useful, because their fans may be employed to stir up the air in the store irrespective of the need for heat. In a store in which simple ductwork is installed for the even distribution of cooling air drawn from outside, it may be economically attractive to use a duct air heater and arrange for re-circulation of the air within the store.

There is a very definite limit to the amount of artificial light which can be used profitably to control extension growth in sprouting seed potatoes. After that initial period of growth during the single sprouting phase, the tempera-

ture of the store must be kept down to the level which, in conjunction with the light intensity actually available, will limit extension growth to the desired extent.

In an extreme case, this could mean the use of refrigeration. In practice, it should be possible to achieve satisfactory results in most parts of the United Kingdom by forced draught ventilation of the store with cold (night) air. Patently, the most convenient way of arranging this is to install a thermostatically controlled, electrically powered fan. Even if a small amount of ductwork is used to ensure even distribution of the cooling air, the resistance to movement of the air will usually be sufficiently slight for a simple propellor fan to be all that is required. This fan need not be particularly large; ten changes per hour of the air within the empty building are amply sufficient. The most consistently satisfactory result will be obtained if the building is moderately well insulated and if air leakage through the structure and through ventilators is minimized.

Intensity and duration of illumination

It is customary[3] to arrange the trays in such a way that the light from the units has to penetrate the stack for no more than the width of one tray. It is also important, in the interest of even illumination, that the lamps cover the whole stack of trays from top to bottom, the end fittings overlapping each other if the height of the stack calls for more than one lamp to each unit. Most early varieties and some later sorts are capable of growing strongly at quite low temperatures (below 42·5°F), and with them it is usually considered desirable to provide one lighting unit for each six stacks of trays. In other cases, one unit is provided for each eight stacks of trays. The units, which are normally switched on for ten or twelve hours daily, must be moved the length of one stack of trays each day, so that in the course of time all receive equal illumination (see Fig. on p. 270). In the absence of any very convincing evidence in favour of one spectrum or another, it is usual to recommend the colour known as warm white. It should not be forgotten that the lamps produce a considerable amount of heat, affecting the need for ventilation and also the magnitude of the installed heating load.

It is definitely worth while to whiten the undersides of the box bottoms. The paint or whitewash will need renewing fairly frequently if the boxes are taken into the field for direct hand planting, but repainting is not a long job, and can be done conveniently on a wet summer day.

Electricity and ware storage

As with seed storage, the basic requirement in ware storage is control of temperature. Potatoes are living things, producing heat; if left untouched in heaps of sufficient height, they would destroy themselves. This danger is avoided by limiting the height of the stack in accordance with the condition of the potatoes and the amount of soil included with them, and by assisting the flow of cooling air through the installation of suitable ductwork.

The circulation of air into and out of a stack of potatoes follows a very complex pattern. Even if slatted ducts of the now customary pattern[4] are installed beneath the potatoes, an appreciable amount of the cooling air will pass downward through the surface of the stack. Furthermore, it is by no

means always the case that air will flow from outside the building, through the slatted ducts and up into the potatoes: strong flows of air (up to 3 cubic feet per minute (c.f.m.) for each ton in the stack) have been observed in the opposite direction and, indeed, are to be expected at times—during a wet cold autumn, for instance.

The power available to operate this convective air flow is very low indeed, derived as it is from no more than the difference in density between the air outside the stack and the air within. It is for this reason that so much stress is laid upon the necessity for installing ductwork of adequate size. Experimental work has established that the optimum size of a potato store duct is 2 sq. inches of free cross-sectional area for each ton ventilated. Ducts of this size are the smallest which will give consistently satisfactory results with sound potatoes in stacks up to twelve feet in height.

Forced draught ventilation an insurance

The pressure required to force air through a stack of potatoes is nearly proportional to the square of the air velocity (in other words, doubling the air flow in any particular case requires some four times the pressure). And it may come about that an increase in stack temperature does not bring about a sufficient decrease in air density to activate the flow of enough air to remove the heat resulting from the increase in temperature—in which case the stored crop is liable to suffer uncontrolled and destructive overheating. This state of affairs is most likely to come about in the autumn, when the crop may be immature; in the spring, when sprout growth may be appreciable; or at any time if the stored crop is diseased or contains an excessive amount of soil. Ductwork alone is some safeguard against the danger of overheating, but the installation of a fan in conjunction with the ductwork increases the safety margin markedly and is very definitely worth while in all cases of storage to heights in excess of eight or nine feet.

Choice of fan displacement

In the United Kingdom it is customary to recommend the installation of a fan delivering at least 40 c.f.m. for each ton being ventilated. This rate of ventilation is a compromise between cost and efficiency, experience having shown that it is capable of extracting heat from the stack at the rate of about 110 B.t.u./ton/hr/1°F temperature difference for a current consumption of some 36 units/100 tons/day. On the Continent, it is not uncommon to advocate rates of 60, even up to 90, c.f.m./ton. However, doubling the rate of ventilation will increase running costs some eight times, unless capital expenditure is increased substantially beyond the not inconsiderable sum required for the larger fan by the installation of ductwork of enhanced size. It might be thought that water loss from the tubers would be reduced at the higher rate of ventilation, because the number of hours of ventilation required to achieve any particular degree of cooling would be reduced. This is indeed so, but the fact is not significant because the routine use of forced draught ventilation is neither necessary nor desirable; weight loss is not of consequence when the fan is in use to prevent massive deterioration, and the only other circumstance in which the fan is likely to be used for more than an hour or two is when it is desired to dry out an over-wet crop. Incidentally,

it should not be thought from this that all wet crops can be dried successfully by forced draught ventilation; it would truer to say that very few wet, as distinct from merely damp, crops can be dried in this way. The tubers remain wet at their points of contact, and bacterial infection starts at, and spreads from, those centres.

Fan pressure and power requirement

The power requirement of a fan is determined partly by the volume of air it is required to deliver and partly by the resistance which it has to overcome. As a guide, it can be said that the resistance of the ductwork alone in a store using slatted wooden ducts affording 2 sq. inches of free cross-sectional area for each ton ventilated is unlikely to exceed 0·5 in. static water gauge (s.w.g.) for rates of flow up to 40 c.f.m./ton. The second component of the resistance—that due to the potatoes themselves—is very variable, because it is so dependent on the amount of soil included with the potatoes and on the extent of sprout growth. The maximum resistance observed in experimental work has been 0·1 inches s.w.g. per foot of stack height and this suggests that an allowance of 1 inch s.w.g. for the loss through the potatoes should be reasonable in virtually all instances. The combined figure of 1·5 inches s.w.g. is a maximum which may be considerably greater than the resistance actually found on any one occasion; it is important, therefore, that the fan rotor should possess a non-overloading characteristic or, alternatively, that the motor should be large enough to supply all the power required by the fan in any circumstances. It is particularly important to remember this if a centrifugal fan with forward curved blades is used. This type of fan is not recommended for the duty; either an aerofoil axial flow fan or a centrifugal fan with backward curved blades should be chosen, if possible. A fan with an overloading characteristic might be used satisfactorily, if driven by an electric motor; a well-constructed adjustable baffle would be required in the main duct near the fan, with an ammeter close at hand to show the load being taken by the motor. In such a case, the motor can be protected by a reliable thermal overload release; tractors cannot be so readily protected, and instances are known of expensive damage having been caused by the uninformed use of fans originally installed for drying grain in ventilated silos.

Automatic control

The use of electricity to drive a fan naturally suggests the possibility of automatic control. Ten years ago, when indoor ware storage was first achieving popularity and the sprout suppressant effect of the higher alcohols was undiscovered, it was thought that there would be some advantage in using thermostatically controlled fans for forced draught ventilation with the intention of maintaining the temperature of the stored crop at 40°F. Experimental work showed that this could be done fairly readily up to about the first week of March, but only at the expense of excessive weight-loss and with severe detriment to cooking quality. However, temperature control through forced draught ventilation has been completely outmoded in this country by the development of an efficient sprout suppression method. It is widely appreciated nowadays that the cooking quality of potatoes is best preserved by storage at 45-50°F, in conditions minimizing weight-loss.

While hand switching is perfectly adequate for starting an emergency ventilation fan, there is much to be said for having a frost guard thermostat, and one should normally be provided. The best place for it is within the main duct, on the downstream side of the fan: in that way the heating effect of the fan is taken directly into account.

*Sprout suppression with nonanol**

Research conducted over many years at the Ditton Laboratory achieved notable success during the late fifties with the discovery of the sprout suppressant effect of nonanol.[5] Development work at Ditton was concluded in 1957, after it had been shown that nonanol could be used easily and successfully on a farm scale—150 tons of potatoes having been kept virtually sprout free in the Agricultural Research Council's experimental store until the end of May of that year. The method of application was very simple. A framework supported a large number of wicks, the lower ends of which dipped into a tray holding liquid nonanol; a small fan was provided to blow a current of air over the wicks and into the store, the number of wicks being varied as required to obtain the correct concentration. A commercial machine is now on the market, working on a rather different principle: nonanol drips via a needle valve on to a small electric hotplate, a fan carrying the resultant vapour into the store ductwork. One difficulty with this method of application has been that the nonanol does not always stay vaporized; in cold weather, some of it usually condenses, either on the cold parts of the machine itself or on the adjoining duct walls.

Nonanol is not a foolproof chemical, by any means. If consistently satisfactory results are to be obtained, then the principles of management should be understood and conscientiously applied; gross mismanagement can result in the total loss of the tonnage undergoing treatment. It should not be thought from this that the use of nonanol is risky, or that it calls for exceptional skill or scientific ability: simple adherence to the basic rules is all that is necessary.

It has already been said that the circulation of air into and out of a stack of potatoes is both complex and unpredictable, whether bottom ducts are provided or not. The total *quantity* of air required by a stack can be determined, however, even if the path that it will take cannot be predicted. This quantity will vary from very little up to a maximum of about 8 c.f.m./ton, depending upon the heat production of the potatoes and the resistance of the stack to the flow of air: 5 c.f.m./ton would be a fairly representative figure to take as a mean maximum for all stacks. If the vapour of nonanol is to diffuse evenly to all parts of the stack, it is essential that the air flow should be controlled and directed in one direction only—from the source of nonanol, through the ductwork, and up into the stack. The first requirement for the successful use of nonanol is, then, a current of air providing 5 c.f.m. for each ton to be treated.

The next point to be considered is the concentration of nonanol in that stream of air—too little would be ineffective and too much might be damaging. The correct concentration is that resulting in the consumption of 4½ pints of nonanol each day (24 hr) for each 100 tons undergoing treatment:

*"Nonanol" is not a trademark, but one of the shorter names for the chemical 3, 5, 5 trimethylhexanol.

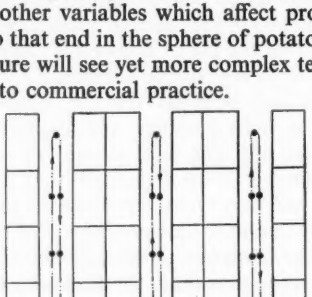
adjustment should be continued until this rate is achieved within ± 5 per cent.

The maximum sprout suppressant effect is achieved only after 14 days continuous fumigation, after which—if treatment is discontinued—the effect is dissipated at roughly the same rate as it was built up. The routine of management is, therefore, to give an initial 14-day period of treatment, and thereafter to treat for periods each equal in length to the elapsed period since fumigation was last discontinued—subject only to a maximum interval without fumigation of 14 days. In practice, it is best to adopt a routine of fairly short periods of treatment (say one week on, one week off), thus maintaining a "reserve" to tide over a time when air could not be blown into the stack because of freezing weather or for some other reason.

Research and the future

The use of nonanol for sprout suppression requires intermittent forced draught ventilation of the stack with what will often be slightly more air than would otherwise have been drawn in. The mean temperature of the stack is thus lowered slightly, which is not desirable. However, there is a second, and far more serious, effect of semi-continuous forced draught ventilation. The "one-way" air stream results in far greater differences in temperature between one part of the stack and another than is usually the case with convective circulation and its haphazard movement. Thus, the temperature of the lower part of the stack may be reduced to a level having the most deleterious effect on cooking quality, while the upper part remains in the 45-50°F range. No way has yet been discovered of entirely surmounting this difficulty. A study of recirculation and other management techniques is in progress, but further research is needed before sound advice can be given.

The tendency in all branches of farming today is towards ever more precise control over environment and the other variables which affect production. Electricity is an indispensible tool to that end in the sphere of potato storage, and there is little doubt that the future will see yet more complex techniques developed and successfully applied to commercial practice.



A diagrammatic layout of seed trays and movement of light units (one unit to eight stacks of trays in this example).

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Britain's Broiler Industry

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The broiler industry started here in 1953. It has been hitting the headlines ever since.

THE present writer was responsible for conducting a survey of the broiler industry for the Farm Economics Branch of the School of Agriculture, Cambridge, the findings of which are in F.E.B. Report No. 53, "Economics of Broiler Production", published in November 1960.

This was more an appraisal of the industry than an examination of the problems of the individual producer, its main purpose being to provide information for possible new entrants to the industry (and for those in it thinking of expansion). The above intention gave rise to a "returns to capital" approach.

A good deal of capital is needed initially to get going in broilers. The house itself is of a fairly complicated specification; it needs very efficient insulation to help maintain as constant a temperature as possible both summer and winter, and it must also be well ventilated without creating draughts. At the time of the survey, capital costs of housing—i.e. site clearance, the house and its fixtures (overhead rails for food hoppers to run on; bulk feed hopper and fans), its erection and the installation of water and electricity—amounted to 10*s.* per sq. foot or in other words, 8-9*s.* per unit of bird space. (The space allowed per bird varies from about 0·7 to 1·0 sq. feet.) Any attempt to economize on the structure of the house is ill advised.

Brooding, feeding and watering equipment costs another 3-4*s.* per sq. foot.

The birds arrive as day-olds and require brooder heat, which will usually be tailed off and removed at about 5-6 weeks. The brooder equipment must be portable, or so organized that it does not take up valuable floor space and interfere with bird movement when not required over the last month, when the house will be most crowded because of the birds' rapid growth over this period. Various fuels and methods are used. Hot water radiators, paraffin, gas and electric ovens and, more recently, electric floor heaters are all in common use; there appears little to choose between them on technical grounds. The range of cost per bird varied from $\frac{3}{4}d.$ to $2\frac{1}{2}d.$ This is composed of the fixed cost (depreciation and obsolescence) of the initial capital outlay and the variable, i.e. running, cost of the fuel consumed over the brooding period.

Feeding equipment falls into two major categories: mechanical feeding and tubes or trough feeding. In all practical circumstances tubes are cheaper than troughs, and nearly all broiler feeding in the U.K. is by hanging tube feeders which are raised higher as the birds grow to prevent fouling and spillage of food. Mechanical feeding, which is common in the U.S.A., has not caught on here. It requires a much heavier capital outlay than tube feeders, and therefore carries a higher fixed cost per bird; on the other hand it uses

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less labour (the variable cost), and therefore a main determinant in the choice between tubes and mechanical feeding is the price of labour.

The saving from the use of a mechanical feeding system appears to be not greater than 1*s.* 5*d.* per bird in this country, with labour priced at 5*s.* an hour. The total labour cost per bird is 2½-3*d.*; feeding time takes up approximately one-third of this and mechanical feeding can therefore only save some part of 1*d.*

The provision of water facilities is not expensive. Most new houses use hanging, valve-controlled drinkers, whereas many of the old houses had guttering (attached lengthwise along their sides) down which there was a continuous flow of water. Total cost, for both types, is in the region of £100-120 for 5,000 birds.

The total fixed capital required, therefore, is in the region of 13-14*s.* per sq. foot, or 12*s.* per unit of bird space. Total variable costs (see the table below) are around 5*s.* a bird. The second batch may be under way before the producer is paid for the first, and even though credit is available from hatcheries and feed merchants, it was felt advisable to budget for another 3*s.* of working capital for starting the second batch. Accordingly the working capital needed is 8*s.*, and there is a total capital requirement of £1 per unit of bird space. Thus if, after allowing for depreciation, there were profits of 6*d.* per bird on each of four batches there would be a yearly annual return of 10 per cent (2*s.* on a capital outlay of £1); if the profit per bird fell to 3*d*, the return would be 5 per cent and so on. At low levels of earning it is well to bear in mind that the capital could probably earn a safe, clear 3 per cent in gilt-edgeds, and that the lower the per bird profits the riskier the enterprise becomes; and yet risk bearing should carry high rewards. One needs to rear on a very large scale to be able to carry small margins.

Returns

At the time the survey was made the cost structure was as follows:

Cost structure of broiler production for the period October 1957—*August* 1959

Variable Costs (per bird)	*s.*	*d.*	*per cent*
Chick	1	3	24
Food	3	6	67
Other		6	9
	5	3	100
Depreciation		3	
Total Cost	5	6	
Average net sales return per bird (i.e., after deducting packing station charges	6	6	
Net profit per bird sold	1	0	

Returns are influenced by both weight and grading, and batch profitability is also affected by the mortality rate (average 4·1 per cent).

The profit of 1*s.* per bird is most certainly too high for present conditions, and the writer is unprepared at this time and from this distance even to guess at today's profit levels.

Some time was given in the original report to an examination of the prospects for broilers in the national diet of the future. Before further mention of this, a brief look will be taken at two ways by which some producers attempt to increase profits.

Poussin production

It will not have escaped notice that if house capacity is determined by density levels at eight weeks and over, there must be a fair amount of unused space over the first half of the production cycle—particularly as the birds double in size over the last four weeks of their ten weeks' life. Some producers therefore put in extra birds as day-olds, and remove them as poussins at 6-7 weeks. Some do it on a small scale, supplying local hotels; others do it on a larger scale, supplying merchants with large retail outlets. Shipping lines take a fair amount of this trade. Profits of 1*s.* per head have been made. As a sideline enterprise the poussin needs only to cover the cost of itself as a chick and the food it eats—which will not be more than 2 lb and which the bird will convert very efficiently.

However, having poussins alongside broilers does present various technical problems, and the overall view is not quite so rosy and uncomplicated as this theoretical picture might suggest. Many people would claim that an adverse effect on the birds left to go to broiler weights is a sometimes hidden cost of this type of poussin production. Certainly would-be entrants to broiler production should not budget for profits from poussins (the market for which is much more circumscribed than for broilers), but only consider the possibility when successfully established in broilers.

Home mixing

The economics of home mixing are the subject of seemingly endless debate and controversy. Mixing broiler foods is a far more complicated matter than compounding feeds for cattle and pigs, or even for laying hens. A wide nutritional knowledge is required, and then there is the mechanical difficulty of ensuring the correct mixing of the essential trace ingredients into the bulk of the food. If it can be done successfully the savings can be considerable (as much as £4 per ton—broiler feeds are in the £40 plus region per ton), but very few producers attempt it. The extension of bulk delivery with its subsequent discounts will lessen the gain from home mixing, too.

Complete home mixing requires either a large broiler output, and therefore a large broiler feed tonnage requirement, to spread the overheads of the equipment or broiler production on a farm where most of the necessary machinery already exists. The small producer would be well advised not to try the complete home mixing of his foods, although he may usefully compromise by buying in his maize and wheat as straights and bulking the ration with a compounded broiler supplement. Pelleted food is looked upon as essential for best returns, and the home mixer can hardly pellet his food any cheaper than the price he will be charged by the compounder for this service (15*s.* per ton when the survey was made). The pelleter is also an expensive piece of equipment—£400 and over.

Future market

What of the future? Food sells in a very competitive market, and the place of poultry in the national diet is partly determined by its own price and partly by the supply and prices of such things as beef, lamb, pork, cooked and canned meats and, of course, other poultry—including the cull hen, where price has been drastically pushed down by the broiler.

Forecasting future demand for meat in general and broilers in particular is a complicated, lengthy and hazardous business. Who can say how far the present trend in home-produced fat lamb will go? Will Australian graziers turn more to fat lamb production if the price of wool continues to fall, and if so how much of this will move into world markets? Will housewives be prepared to pay more for the convenience of cooked and canned meats for mid-week meals, and to what extent can prepared and packaged broilers cash in on this trend? What influence will the change in the age structure of the population over the next decade or so have on meat consumption habits? All these are obvious imponderables, and yet all are relevant to the future demand for broiler meat. (This topic is discussed more fully in the original report.) What the future ratios between the components of the meat group will be is anybody's guess.

THE MINISTRY'S PUBLICATIONS

Since the list published in the July 1961 number of AGRICULTURE (p. 221), the following publications have been issued.

LEAFLETS

Up to six single copies of Advisory Leaflets may be obtained free on application to the Ministry (Publications), Ruskin Avenue, Kew, Richmond, Surrey. Copies beyond this limit must be purchased from Government Bookshops, price 3d. each (by post 5d.)

ADVISORY LEAFLETS

No. 94. Maize for Fodder and Silage. (*Revised.*)
No. 257. Green Manuring. (*Revised.*)
No. 391. The Preparation of Strawberries for Market. (*Revised.*)
No. 479. The Coypu. (*Revised.*)
No. 494. Feeding Value of Grass Silage. (*New.*)
No. 501. Winter Rye for Spring Grazing. (*New.*)

FIXED EQUIPMENT OF THE FARM LEAFLET

No. 48. Potato Chitting Houses. (*New.*) 1*s.* (by post 1*s.* 2*d.*)

FARM MACHINERY LEAFLET

No. 13. Ventilated Silo Grain Driers. (*Revised.*) 6*d.* (by post 8*d.*)

Farming Cameo: Series 2

40. Witney District, Oxfordshire

W. E. RICHARDS, B.Sc., N.D.A.
District Advisory Officer

THE brisk and pleasing market town of Witney is the natural centre of its district, which extends west of Oxford city as far as the Gloucestershire border near Burford. The A.40 trunk road, London to Fishguard, traverses the district and the main soil types. From it the traveller can gain a fair impression of the country, and some idea of the development that this area shares with most of south-east England.

Farming has been the main occupation until recent times, with only the famous blanket mills, glove manufacture and quarrying as small local industries. Now the district lies under the shadow of the motor factories of Oxford. Its population has increased by 20 per cent to 34,000 in the past ten years. Witney urban district itself has jumped by 40 per cent to 9,000 population. Here a new motor accessories factory competes for labour, and pulls men from the land. On a total agricultural area of 75,000 acres, the 500 holdings of 5 acres and upwards hire only 1,200 men and women.

The Cotswold Hills enter the district near Burford at a height of 650 feet. This distinctive limestone plateau dips gently east and south to about 300 feet, where it is overlain by Oxford Clay along a line running south west to north east through Witney. All the drainage is to the upper Thames, the quiet fishing streams of Windrush and Evenlode being the main tributaries. The clay vale is remarkable for its large stretches of terraced, oolitic river gravels and for its wide expanses of alluvium. The gravels are extensively worked near Eynsham.

Soils on the Cotswolds are mostly stone-brash, shallow over friable limestone. Alkaline and well-drained, traditionally under barley and folded sheep, this belt is mostly in large farms. Mechanized corn-growing is profitable, with barley as the main cereal, sown early to avoid spring drought and with potash as a necessary fertilizer. Folded sheep and their root crops have practically gone, replaced by dairy cows on three-year leys with piped water. Sheep have made a rapid come-back, but the ewes are mostly grass breeds or their crosses and the Suffolk is the most popular ram.

The Oxford Clay forms a cold, wet and heavy soil, difficult to farm. Much is under grass, carrying many dairy cows and some beef cattle. Arable crops can be grown with proper drainage and modern tackle, but good tilths for spring crops are often hard to get. Farm sizes tend to be smaller, and pigs and poultry frequently supplement the output from cattle and sheep.

The gravels of the terraces and flood plains of the Thames are dominantly calcareous. Having good drainage they are mainly in large arable fields. Early sowing is the aim with an annual rainfall averaging only 25 inches, and barley is the main crop again. Dairy cows are important on the leys here. The river alluvium, often a rich organic soil, is in arable wherever the water-table allows. Throughout the district the Thames Conservancy has done much by dredging and river control to improve land drainage.

The general picture is of a district with fairly large farms under the plough but with well-stocked grassland. Of 75,000 acres, only 1,000 is returned as rough grazings. Permanent pastures are shown as less than 25,000 and temporary grasses at over 16,000 acres. Cereals exceed 28,000 acres, two-thirds being barley. The remaining tillage and orchards scarcely total 6,000 acres. The district carries over 20,000 cattle, of which 5,000 are dairy cows, and about 13,000 ewes. Pigs include 1,800 sows, and there are nearly 100,000 hens. One large farm accounts for nearly half of the district's 20,000 turkeys.

Proctor and Rika are the popular barleys, Cappelle is the favourite wheat. Yields average well over 25 cwt per acre, depending on season, and are still rising. Tanker combines and bulk handling reduce labour costs. Many farms use their own barley for stockfeed, home mixed or prepared at a local mill, using purchased protein. Mixed corn, peas and beans are scarcely grown now. The kale acreage seems to have reached its peak, and all other root crops continue to decline with economic conditions, thin soils and scarce labour. A small area of lucerne is found in most parishes and a local strain of sainfoin is sometimes grown as a long ley on Cotswold soils for hay or sheep grazing. Local strains of red clovers and Aberystwyth varieties of grasses and white clover are grown for seed, to a total of 1,000 acres. Pigeons are troublesome pests on legumes and brassicas.

Horticulture is not of great importance in the district, and productive orchards are few. Some market gardens are found on the valley soils at about 200 feet near Oxford. Glasshouse crops are grown in two villages of very small holdings near Witney. There is one very large specialized mushroom farm. Cabbages and potatoes are irrigated on a few farms near the rivers.

Grassland has received much attention in recent years. Italian ryegrass and timothy—fescue leys are widely grown. The forage harvester now makes much more, and better, silage for conservation under the many roofed silos. Hay-making has gained added interest from the new machinery and rapid methods.

Recent winters have urged the need to keep cattle from poaching heavy land. New cattle yards, often fully covered, are to be seen all around Witney. Dutch barns and their extensions, loose housing and parlour milking are common now. Very full use of grant aid can be seen. The few large estates, the medium-sized landowners and the many owner-occupiers are mostly convinced of the savings to be won by well-planned buildings for cattle. Shortage of bedding straw is often felt. The British Friesian is the common breed, with renewed interest in Channel Island cattle on the smaller farms. The Hereford cross is the most popular beef animal. Many calves are brought into the district to rear and finish on the larger arable and clayland farms.

There are few really sizeable pig herds. Large White and Landrace are kept pure bred, and their boars may be used on the Wessex sow, which is often run out of doors. Local factories take cutters and baconers, but many pigs go as porkers or heavy hogs. Poultry are important on many farms, and there are several medium-sized specialist poultry farms, but no great broiler establishments.

The district is favoured for settlement and high prices are paid for farms. Rising costs and falling prices present a challenge to local farmers with their heavy dependence on barley, milk, beef and sheep. They have the character and ability to surmount any difficulties.

Your Fixed Equipment

Timber in Farm Buildings

MICHAEL F. TILLEY, A.R.I.B.A., A.M.T.P.I.
Agricultural Land Service

TIMBER has a number of characteristics which make it a particularly suitable material for farm buildings. This applies not only to the odd repairs and minor adaptations which most farmers carry out themselves, but also to the larger structures more usually left to outside building contractors or specialist firms. For the small do-it-yourself jobs timber has the obvious advantage of being easily worked on site with only a minimum of hand tools. It is also infinitely adaptable, and can readily be cut and fitted into the odd corner or place where certain other materials cannot.

But for all types of structure, large or small, permanent or short-lived, timber has the following advantages of particular interest to farmers:

1. Size for size, timber is more resilient than any other material. This means that timber stanchions or other structures are less liable to accidental damage from heavy moving machinery. If they are so damaged, repairs can usually be more readily carried out.

2. Correctly detailed and used in the proper way, timber needs little maintenance.

3. When it comes to subsequent alterations to suit changed circumstances or different farming techniques, a timber building will usually be far easier to adapt than any other.

4. Timber is a "warmer" material than either steel or concrete. In intensively stocked buildings such as piggeries, poultry houses and the like this is a matter of considerable importance. If steel or concrete roof trusses or purlins are used to support an otherwise insulated roof, the heat transfer which they so readily permit along the lines of the principal rafters and purlins and the hook bolts associated with these last makes it practically impossible to avoid condensation in some places. Relief from this condensation can only be obtained by lowering the stocking rate or permitting unduly high levels of ventilation, neither of which is desirable. Timber does not suffer from this disadvantage, however, and it is possible to fix the roofing sheets above the purlins and the insulation or roof lining below them without this risk of rapid heat transfer.

Until recent years the sizes of timber structural members were based on rules of thumb which left a wide margin for error. This meant that in most cases far too much timber was used. Modern engineering techniques have put the structural use of timber on a far more scientific basis, saving a considerable amount of material, and bringing timber structures to the point where they can compete in price with steel and concrete. The use of bolted steel timber connectors is largely responsible for this, as they have strengthened what used to be the weakest part of most timber structures—the joints between one member and another. As these connectors also largely remove the need for accurately cut joints they have considerably simplified

construction in timber. They have also led to a far more consistent standard of jointing and one to which definite calculable strength values can be applied.

Although the erection of large and complicated structures is best left to the specialist firms, the use of timber connectors in simple structures should not be beyond an intelligent layman. There are a number of free leaflets and diagrams giving guidance in their use, which should be read and followed carefully by anyone intending to use timber connectors.

To get the best out of timber, however, it is necessary to recognize and allow for its other, and less desirable, characteristics. Chief among these is a dislike of being kept damp for any length of time. This not only considerably weakens timber but also leads to its premature decay. Stanchions or other timber members are best not built into the ground. They should be supported on concrete piers or brick walls, with a damp-course laid between the timber and its base.

Where this is not possible, and in all cases where the wood is likely to be frequently wetted, or built into damp or unventilated places, timber treated with a preservative *under pressure* should be used. Creosote is probably the oldest and still the best known preservative, though there are many others just as good which do not impart that unfortunate blackness to the surface. Treated in this manner timber should last forty years, probably considerably longer. It is also free from fungoid and insect attack. This type of pressure treatment is not expensive, and should not add more than 12 to 15 per cent, depending on location and distance from the nearest plant, to the cost of the timber.

All horizontal timber members used outdoors should be weathered, that is to say sloped to throw off the water. Care should also be taken in all jointing of members to ensure that open cuts and holes facing upwards which may fill with water are protected. The "end grain" (those ends of the members which are cut at right angles to the axis of the original tree-trunk) should also be protected as far as possible. Not only does this end grain usually come rough from the saw and so is able to hold water, but the fibrous nature of the tree makes it more able to absorb water from the end.

Some timbers, particularly ground floor members, whilst not in direct contact with the ground, may still become rotten and attacked by fungus because a pocket of damp stagnant air is trapped between them and the ground. Care should be taken to ensure adequate ventilation below floor level to avoid this. Where this is not possible, pressure-treated timbers should be used.

It is hoped that this article will give the reader some idea of the possibilities of timber for farm buildings, and also some of the points to watch in its use. Timber is a wonderfully versatile and adaptable material, and used properly it will produce buildings as serviceable and as long lived as any others.

Handbuch der Tierzuchtung

Volume 3: The Breeds (First half-volume)

THE massive work on animal husbandry* that Hammond, Johansson and Haring are preparing under joint editorship has reached volume 3, which, like its predecessors, appears as two separately bound books. The first includes a detailed list of the chapter headings for the second, which deals with the breeds of pigs, sheep, poultry (including ducks, geese and turkeys), fur-bearing animals and rabbits.

The first "half-volume" begins with 66 pages of general introductory matter, among which one has to search for the plums. The remainder comprises 140 pages on breeds of horses and 271 on breeds of cattle, a proper allocation in view of the relative economic importance of the two species, but one which will require justification for many British and Commonwealth readers who regard the working horse as a back number; this is very far from being true elsewhere. The *Handbuch* discusses this question only as it affects Norway, where the equine population rose from 151,000 in 1890 to 238,000 in 1946, and fell by 1956 only by 40 per cent to 142,000. Horse breeds are divided into the English and Arabian "thoroughbreds", light horses, heavy horses, and ponies, and each group is considered in turn as bred in the different parts of the world. It is instructive to compare these reports with those Horace Hayes published in 1907 on the same subject. Professor Miller of Newmarket writes on the thoroughbred, Professor Ensminger of Pullman, Washington on the American trotter; while Aparicio of Cordöba (on mule breeding), and three German authors, Uppenborn, Löwe, and Saenger cover the remaining aspects of the subject in an exhaustive and interesting manner. It is fascinating to read of the recent successful German efforts to develop a genuinely all-purpose light horse.

The situation regarding cattle-breeding in each European country is considered in detail. The British breeds of cattle are discussed by German authors, Professor Haring and Drs. Winnigstedt, Messerschmidt, and Sieblitz. Professors Giuliani and Smalcelj deal respectively with Italian/Spanish and Balkan/Asiatic breeds. It is noteworthy that in several European states cattle of British origin play an important part in the economy. For most breeds the numbers of registered herds and annual herdbook entries are given, and recent breed average yields wherever these are available. Overall census figures, however, as for the horse, are not consistently quoted; thus there is no figure for beef cattle numbers in the U.S.A.

John Maule of Edinburgh contributes a chapter on the exploitation of improved breeds of cattle under tropical conditions, considering Brown Swiss and Criollo cattle as well as five British breeds. Professor Rhoad of Texas has written one of the most interesting cattle chapters on the Santa Gertrudis and four other new beef breeds, created by crossing to suit particular environments. The Canadian cattalo and American experiments on the development of heat-tolerant dairy animals are also described.

The book is profusely illustrated with good photographs; there are many clear, compact tables, which will indeed be found easier to follow than much of the text by many non-German readers. As with previous volumes this is too good a work not to be translated into English. A reference list gives details of 206 text-books and official reports.

Volumes 1 and 2 were reviewed in the June 1959 and April 1960 issues of this JOURNAL.

F.L.M.D.

*Published by Paul Parey, Hamburg and Berlin. 98 *D. Marks.*

In Brief

WASTE FOOD KILLS

Your kitchen scraps could kill a herd of cows. Carelessness with waste food can cause outbreaks of foot-and-mouth and other serious animal diseases.

No doubt a good many farmers are beginning to feel there isn't the risk to their livestock there was a few months ago when foot-and-mouth was rife. As a result, perhaps they are being less strict in their precautions. But this laxity could have terrible results. Farmers, country dwellers and visitors to the country should always be meticulous in feeding livestock and in disposing of waste food.

Swill is a useful feed for pigs and poultry, but stock-owners who use it must be alive to its dangers. The viruses of foot-and-mouth, fowl pest and swine fever can stay alive for very long periods—perhaps several months—in meat, bones and offal. Any swill bin can contain material in which they are present. These dangerous viruses must be destroyed by boiling before the swill is fed to animals or poultry.

Swill feeders have legal responsibilities for taking precautions to prevent the risk of infection. All waste food must be sterilized by boiling for at least an hour before being fed to animals, and there must be no contact between raw swill and the sterilized material or any other feedingstuffs. Livestock should not be allowed to get at raw swill, nor to scavenge near boiling plants. Containers and vehicles used for carrying raw swill must not be used to carry animals or poultry (or anything else which livestock might come into contact with) until they have been properly cleansed and disinfected. Workers who handle raw swill should wear gumboots and overalls, and change or disinfect them before handling or feeding livestock. The containers in which swill is kept and carried should be proof against dogs, cats, birds, and vermin, all of which can carry disease on their feet and bodies. If all these rules are strictly followed, the feeding of swill need present no dangers.

But no matter how carefully farmers follow these rules, all their efforts can be ruined by the carelessness of others. Whether you are a country dweller or just a visitor, remember even the kindly practice of giving scraps to pets or farm animals can lead to disastrous outbreaks of disease. Never throw food to farm animals, nor leave it where they or pets or vermin can get at it; and, if you give raw bones or meat to your pets, make sure that they cannot carry them on to nearby farmland. Always clear up the remains of any picnic you have, and burn them or take them home for disposal. Likewise, if you live in the country, burn or bury kitchen scraps whenever possible.

You just can't be too careful with waste food. Foot-and-mouth, swine fever and fowl pest cost this country millions of pounds a year. Don't you be the one to blame for any future outbreak.

PLAN YOUR SUMMER GRAZING

When your neighbour has plenty of good grazing in August don't put it down to good fortune. The chances are that it is the result of his careful planning.

It is relatively easy to grow grass in the spring and, as a rule, in autumn. It is harder to have a good supply of nutritious grass in July and August. Irrigation helps, but not every farmer can provide it. On the majority of farms some other approach has to be made to this problem and it is here that farm planning is so important.

Where grass is produced from leys, thought should be given to the make-up of seeds mixtures, and some of the land should be sown with mixtures likely to withstand the droughty summer months. Ryegrasses tend to be stemmy and unproductive at this time of year, while cocksfoot can be very productive. Much can be done by choosing suitable seeds mixtures, but this calls for thinking a year or two ahead.

Choosing the most suitable seed mixtures is not the end of the planning problem; it is only the beginning. The use to which each grass field will be put should be carefully worked out so that all the grass acreage can contribute to the economy of the farm as a whole. During the early months of the year you should decide which fields are to be used for hay or silage, and which for early bite, midsummer grazing, and so on. Don't just hope that it will rain on the field needed for grazing while the sun shines on the hay in the next field!

Grass cannot give of its best at any time of year, least of all in midsummer, unless it is well fertilized. Basic slag, complete fertilizers and straight nitrogen all have a part to play. How often has one seen the well-fertilized pasture standing out—green and productive—from its less well treated neighbours in a droughty summer? Generous fertilizer treatment is a "must" for grass. But it is no use waiting until there is no grazing in, say July in a droughty summer, before deciding to put fertilizer, probably nitrogen, on to the pasture. That won't do any good. It should have been put on months earlier. Even nitrogen, which acts quickly, should have been put on at least a few weeks earlier.

Topping pasture over with a mower or topper prevents it running up to flower and becoming stemmy. This should be a routine operation as it encourages the grasses to grow and produce for a longer period. Silage-making, too, is an integral part of good grassland management. By this means any surplus grass during early summer can be taken care of and the grass stimulated to grow in anticipation of a dry July and August.

If you are short, or likely to be short, of grazing this year there is probably little that you can do about it, and you will probably have to turn to hand feeding. This will ensure that your stock does not lose flesh or milk, but it will add to your costs of production and thus tend to reduce your profit. Don't be in this position next year. Start thinking about it now.

W. S. Rayfield.

KEEP YOUR GRANARY FREE FROM PESTS

It seems likely that much of the current harvest, especially barley, will be stored for a longer period than formerly and will therefore be more liable to deterioration from attack by stored products insects, of which the most common are the saw toothed grain beetle, the grain weevil and the rust red grain beetle. These can reduce the value of grain by eating the endosperm or the germ and by causing heating as the result of activity within the bulk. Grain merchants, millers and maltsters may refuse to buy infested grain, especially in conditions of glut, or they may accept it only at a reduced price or after it has been fumigated.

Since attack starts in store, all grain stores should be thoroughly cleaned before harvest and residues destroyed by burning or grinding. Such cleaning should include all parts of grain handling machinery, air ducts and spaces beneath ventilated bins, spaces between granary walls and grain bins and the interiors of grain driers and combines. All second-hand sacks likely to be used in harvesting or storage should be fumigated.

The insides of bins and the floors and walls of granaries should be sprayed with one of the following residual insecticides: malathion, DDT or lindane. The first should be used if saw toothed grain beetles are present. The insecticides should be applied as dispersible powders mixed with water. Smoke insecticides containing lindane or DDT or a mixture of the two can be used for treatment of spaces inaccessible to sprays.

It is most important that grain should be properly cooled. By proper use of the cooling sections of grain driers and by blowing cold air through ventilated bins at night it is possible to cool grain to below 65°F after harvest, at which temperature the saw toothed grain beetle cannot breed. It is quite practicable to do this without raising the moisture content of the grain to dangerous levels.

It is also possible to mix malathion dust with uninfested grain as a protection against insects, at a rate not exceeding 10 parts per million.

During storage, which should be in granaries used only for grain produced on the farm and not also for feedingstuffs, on which storage pests might be introduced, grain should be inspected once a week. If storage insects are seen or any steady rise in temperature is observed, infestation may be present and control measures may be necessary.

J. A. Freeman.

WINTER RYE FOR SPRING GRAZING

Have you thought about the possibilities of winter rye as early spring bite for sheep? The practice used to be popular, but it fell off until about 10 years ago. Dairy cows, as well as ewes and lambs on free range, will welcome it, particularly in the extreme south west. But attention to certain aspects of its cultivation and management are called for, so that if the idea is attractive you should ask the Ministry's Publications office (address: Ruskin Avenue, Kew, Richmond, Surrey) to send you a free copy of the new leaflet (AL. 501).

Early sowing—mid-August to early September—is of vital importance, especially on the higher ground and in difficult situations. At the latest the seed should be in before mid-October, unless conditions are exceptionally favourable. And the seed should be *drilled*, not broadcast. It will come most opportunely as a first crop after a ley.

The variety Lovaszpatonai is recommended; alternatives are Ovari, Bernberg, and New Zealand C.R.D.

GUARDING STATIONARY FARM MACHINERY

Farmers and farm workers are reminded that the Agriculture (Stationery Machinery) Regulations 1959 and the Agriculture (Threshers and Balers) Regulations 1960 became fully operative on 14th July 1961 and 1st August 1961 respectively. These Regulations apply to all agricultural machinery designed or adapted for stationary use only on farms where workers are employed.

Components of stationary machinery must be situated or guarded in such a way as to protect a worker from contact with them. Drum feeding mouths of threshers must also be guarded, and the decks of some threshers must have guard rails. Clearly marked stopping devices and means of disconnecting power must be supplied. Other requirements relate to maintenance of belts and natural or artificial lighting.

Workers must make use of guards and report damaged ones.

Full details are given in two free leaflets (Stationary Machinery and Stationary Threshers and Balers), which are obtainable from the Ministry (Publications), Ruskin Avenue, Kew, Richmond, Surrey or, in Scotland, from the Department of Agriculture for Scotland, Broomhouse Drive, Edinburgh 11.

THURGARTON LITERATURE

A set of ten attractively presented and interesting booklets on farming practice at Thurgarton, Notts, has been issued by Boots. Among the subjects dealt with are Quick Haymaking, Feeding Dairy Cattle, and Electric Fencing. The booklets are obtainable free from Boots, Nottingham.

Book Reviews

Land for the Future. MARION CLAWSON, R. BURNELL HELD and CHARLES H. STODDARD. John Hopkins University Press. 68*s*.

The importance for the English reader of this study of land use in the U.S.A. lies not so much in its actual content but in the method of making the inquiry, and even in the fact that it has been made at all. If the U.S.A., feeding her own population, is concerned with the matter, how much more should we be so in Britain, seeing that we are a small country and grow only half our own food? At the moment Britain has 544 people per square mile while the U.S.A. has 56.

Land for the Future studies the U.S.A.'s problem of present and future land use very admirably. It considers land use in all its aspects, beginning with an examination of the country in both space and time. The authors see the U.S.A. as contracting, and have an interesting map to illustrate how the increasing speed of transport tends to annihilate distance. This map starts in 1921; if it dated from the pre-railroad era, and was on the same scale, it would have started the size of a table top.

Chapters on land for urban use, recreation, agriculture, foresting, grazing and miscellaneous uses (railways, airports, roads, and wild life reserves, etc.) follow. The future use of land in these particular categories is considered and there is a final chapter on this subject as well. Some of the forecasts are of interest to the English reader. For instance, the demand is expected to increase for higher cost food in particular, all of which (except for certain exotics, coffee, bananas, etc.) can be produced in the U.S.A. If our population and demand for food grow at similar rates (as they may), where is the produce going to come from? *G.O.*

Harvests and Harvesting through the Ages. NORMAN E. LEE. Cambridge University Press. 15*s*.

In his preface Mr. Lee thoughtfully warns us that any connection between the title and the subject-matter of this book is purely coincidental. The point is a reasonable one, for it would be difficult to summarize his theme satisfactorily in any single phrase. He is certainly concerned with harvests down the centuries. But he is equally concerned with the crops that produced those harvests and, more generally, with the various means and methods by which man has contrived to feed himself. He has, in fact, written an elementary history of man as a gatherer and producer of food. Apparently designed for senior school-children, this book is simple in presentation and conversational in style. In content it is wholly fascinating and readers of any age will appreciate and enjoy it.

Mr. Lee begins his tale in the days before farming, when men searched for roots, berries and wild honey and hunted the bison and mammoths which they painted with such uncanny skill on the walls of their caves. He ends it with the formation of the International Rice Commission in 1948 and a map showing the world distribution of tractors. In between we see the generations gradually assembling the multitude of resources and techniques which we today take for granted—taming animals, discovering how to make butter, growing the new crops which came to them along the caravan routes or across the seas, developing machines for the tasks of the field and the steading. We have indeed inherited a prodigious legacy and we need reminding from time to time of the countless efforts of muscle and, more significantly, of mind which went to its creation. For this is the epic of man the tool-maker, *Homo sapiens et Faber*.

By formal scholarly standards, this is probably not a very good book. But it has the two ultimate virtues. It has a good story to tell and in its unpretentious way it tells it superbly. You may be an adult or a schoolboy, you may or may not be interested in history, but if you pick up this book you will read it to the end. And when you have finished you will want to read more about the corn that grew in Egypt and the "honeygrass" that Alexander's soldiers found in India, about the saddle quern that made mock of Samson's strength and "the acres of the rye" of Shakespeare's countryside, about barbed wire and its economic consequences, about Federation wheat and the new

harvests of Africa. Then, one day you will remember with gratitude the book which turned your mind to these things.

Harvests and Harvesting is well produced and admirably illustrated with pictures and the right kind of maps. Yet its very success emphasizes its one major weakness. Mr. Lee's notes on further reading are scrappy and inadequate. Perhaps he might include in the next edition a chapter giving systematic guidance on the means of satisfying the curiosity that he has so effectively aroused?

N.H.

Rhododendron and Camellia Year Book 1961. The Royal Horticultural Society. 12*s.* 6*d.*

The aim of the Royal Horticultural Society in issuing its year books about specialists' crops would seem to be to offer, through the informal exchange of experience, stimulating "winter reading" together with accounts of achievements during the year under review; practical advice and records for present and future reference are important ingredients when a year book is considered as part of a valuable series.

All these objectives are attained in this particularly interesting issue. Rhododendrons take pride of place as befits the finest of shrubs for lime-free soils. The well-balanced series of articles includes consideration of rhododendrons as garden plants in the King of Sweden's collection at Sofiero and in the Howth peninsula in Eire. Accounts of the London Shows are more than a mere catalogue of prize-winning entries; that of the Scottish Shows emphasizes the predilection of Scottish gardeners for species, in contrast to the hybrids, which, for quality and quantity, dominate English exhibitions. Musings on inter-specific hybrids place some interesting experiences on record, while another article on recent hybrids indicates modern trends in colour preferences together with some useful notes on pedigrees. It is pleasing to find an account of original scientific research; this is an investigation on mineral deficiencies and reveals the hitherto unsuspected importance of magnesium in the problem of leaf-chlorosis.

Camellias, another speciality of the acid-soil gardener, occupy a smaller, but not inconsiderable, part of the year book, although the section is perhaps not yet commensurate with the increasing popularity of these plants. Attention is drawn to advances and recent publications in the United States, where camellias are now so highly esteemed. Other articles provide cultural advice and records useful to those growers in England whose interest in camellias has recently been aroused.

This year book is admirably illustrated with excellent black and white plates and eight coloured plates of varying quality.

The rapid exhaustion of previous issues of the year book, only four of the fifteen in the series being still available, has encouraged the Society to make a larger printing this year, and this is likely to be fully justified.

K.H.J.

Herbicides and the Soil. Edited by E. K. Woodford and G. R. Sagar. Blackwell Scientific Publications, 17*s.* 6*d.*

The behaviour of herbicides in the soil is of vital concern to all who use them. Early in 1960 the British Weed Control Council held a symposium on the subject at Oxford and the four papers presented there, together with the discussions that followed, are included in this report. The numerous references to literature will be most useful to research workers. The style makes no concessions for non-scientist readers, but those prepared to study the report should find the effort rewarding.

Professor L. J. Audus's contribution on the microbiological breakdown of herbicides in the soil is particularly interesting. Many experiments have confirmed the ability of certain groups of bacteria to adapt themselves to utilize herbicides as energy sources. The vastness and diversity of the bacterial population of most arable soils is sufficient to ensure that any soil is likely to contain some individuals adaptable to almost any chemical substance presented to them. Indeed, Professor Audus considers it most unlikely that any organic compound is completely immune to ultimate bacterial attack.

William Fletcher (of the Botany Department, West of Scotland Agricultural College) summarizes more than 250 papers on the effect of herbicides on soil micro-organisms. Present evidence suggests that ionic surface-active agents used in formulating herbicides tend to inhibit microbiological activity whereas non-ionics do not.

The problems encountered with persistent herbicides, outlined by W. van der Zweep of Wageningen, are the regulation of their persistence in soil in different environmental conditions and the protection of crops from their rather unselective action. Risk of damage by contact with pre-planting herbicide may be minimized by using seedlings grown in pressed pots.

Physico-chemical aspects of the availability of herbicides in the soil are treated theoretically by G. S. Hartley of Chesterford Park Research Station; few measurements have been made. He shows how leaching can be influenced drastically not only by differences in soil structure but also by subsequent rainfall and the moisture status of the soil before application.

This is not a comprehensive survey, but the aspects chosen are explored in depth, revealing serious gaps in our knowledge as well as demonstrating the considerable amount of information already available from research here and overseas.

S.L.

Electricity and Potato Husbandry. P. T. G. Twiss. Electricity Development Association. Free.

Mr Twiss has done a good service to those in the electrical industry, to the manufacturers and contractors, in preparing this booklet, which is a reprint of a paper delivered to the Rural Electricity Conference at Sutton Bonington in 1960.

It is a comprehensive review of the techniques used in both seed and ware potato storage, naturally with an emphasis on the electrical requirements on the average potato farm. There is remarkably little which one can criticize in other than a favourable manner. It might have been appropriate to emphasize a little more the problems of cost facing the farmer, by giving some figures. There is much in modern electrical equipment which could and would be more widely used for seed storage and sprouting, especially if capital cost did not discourage the farmer.

Artificial cooling in some circumstances is desirable in seed potato stores, but due to cost (as at present understood) little progress is being made in practice. Enterprising manufacturers and contractors please note!

There is also need for a cheap differential thermostat (differential about $\pm 1\frac{1}{2}$°F, not more) for use in forced-draught ventilated seed stores. This is probably a contradiction: such an instrument cannot be cheap. Alternatively, reasonably efficient temperature control could be obtained by a thermostat which maintains a closed circuit on a falling temperature, below a preset maximum, and which opens the circuit immediately the temperature rises. Re-set every day, such an instrument would be reasonably efficient for this work and should not be as expensive as the narrow differential type.

Mr. Twiss omitted to mention lighting and heating over potato riddles or graders. Lighting in the form of flourescent fittings 5 feet long, one each daylight and natural, gives good conditions for the hand picking which so often has to be done in badly lit buildings. Heating in the form of bright emitter lamps or strip heaters eases the work in cold weather. Improving the working conditions means greater output and usually more efficient work.

All those who want a brief review of current techniques in potato storage, with the emphasis on electrical requirements, should obtain this booklet.

C.V.D.

Report and Proceedings of the Fifteenth Oxford Farming Conference. 6*s.* 6*d.* post free. (Obtainable from M. H. R. Soper, Department of Agriculture, University of Oxford.)

Many good things emerge from the Oxford Farming Conference—not least the Report and Proceedings, with full text and discussions, now available for the 15th Conference, whose theme was "Food and Farming in a Changing World".

This Conference has been acclaimed one of the best so far. It started well with Mr. Tristam Beresford's paper on "World Pressures on U.K. Agriculture", the impact of which might be attributed as much to its style as to its pungent content. The general theme of Mr. Beresford's remarks is that farmers as a body are capable of doing much more to help themselves. Perhaps a certain amount of overstatement was justified to make the point. Happily, this paper came from a fellow farmer and not from an "official", otherwise its reception might have suffered more in consequence. Even so, the audience did not recover sufficiently to make adequate comment until the following day!

After Mr. Beresford, there remains a high level of contribution and comment on the home production and marketing of beef, lamb, poultry meat and vegetables; on the effect on the British market of Australasian and North American production, and of

course on the problems of the Common Market. It is noticeable throughout the Report that as much emphasis is placed on the importance of selling as on production. The proceedings are enlivened at appropriate points, as might be expected, by comments on the political implications.

All this and more appears in the report. The discussions as well as the papers at Oxford represent some of the best-informed opinion likely to assemble at any farming conference in this country. Nothing of course can be a substitute for attending the Conference, but a leisurely perusal of the Report and Proceedings is a good second best.

Assembling the papers and the recording of the discussions is by no means the least of the tasks which fall to the lot of Mr. "Mike" Soper, the Conference's hardworking honorary Secretary/Treasurer, who has earned our congratulations yet again.

T.W.

The Cattle Herdsman's Guide. J. S. HALL. Farmer and Stock-Breeder. *3s. 6d.*

It seems unreasonable to suggest that all the essential knowledge of the craft of the cattle herdsman could be condensed into a modest, paper-backed book of 48 pages. Yet that is what Mr. J. S. Hall, principal of Cumberland and Westmorland Farm School, has contrived to do in this little guide. Examining it for omissions I have, on the contrary, found myself absorbing important new facts and the answers to problems that have puzzled me.

How to correct a deficiency of solids-not-fat in milk, for instance. Mr. Hall lists seven methods, which include keeping a high percentage of young cows and heifers in the herd, refraining from milking barren cows for too long and maintaining a twelve-monthly calving interval. I learn, too, that the ingredient in early-weaning calf mixtures which I have found difficult to dissolve in water is tallow. Extremely promising results are being obtained with a new early-weaning mixture containing 5 per cent tallow, we are told, and the author goes on to give the formula.

Starting with calves and calf-rearing, the author takes us through the cow's entire career. He makes cogent suggestions on how to avoid scours, navel-ill and other ailments when rearing calves. A new oral vaccine is recommended as a preventive against husk in young store cattle. We are told that early mating has considerable advantages if matched with a high plane of nutrition. A series of practical rations for milking cows as well as rules for efficient milking are also given. He even manages to include a veterinary guide.

Much of what Mr. Hall says is just common sense, though not so very common, for all that; but the combination of sound, practical lore with well-selected facts and figures makes his little book a pocket Baedeker for every progressive herdsman.

R.W.

New Housing for Dairy Cows in the East Midlands. Nottingham University. We regret that the names of the authors Messrs. K. A. Manning and P. Ingersent were omitted from the review which was published in May.

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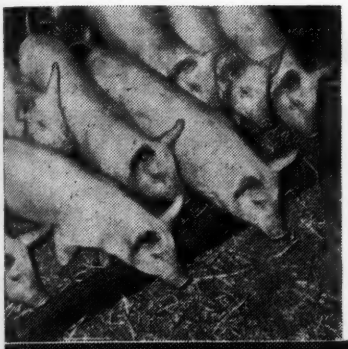

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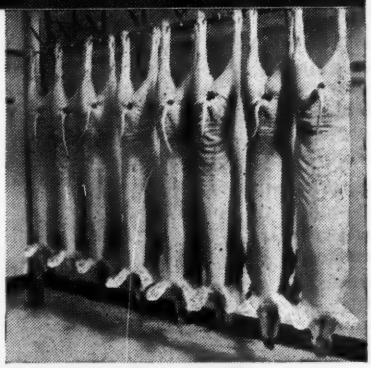

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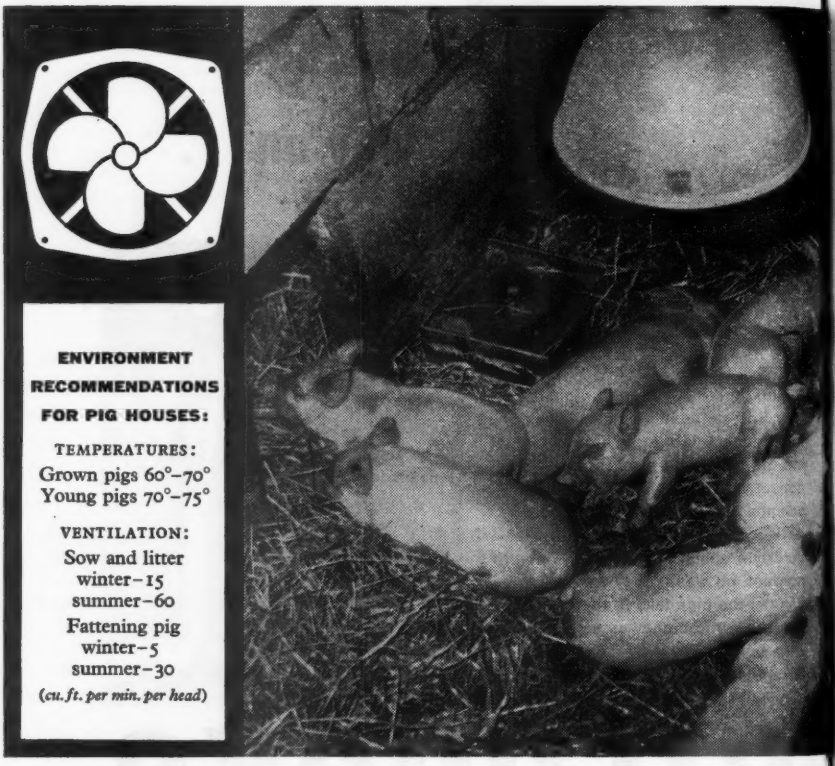

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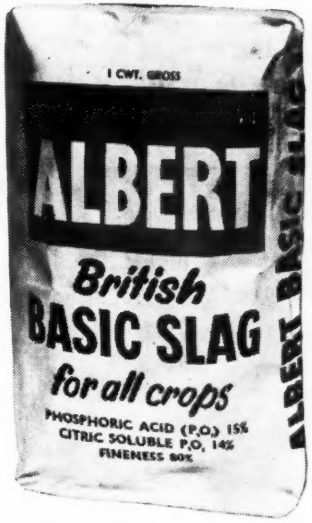

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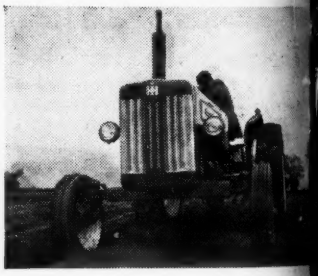

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